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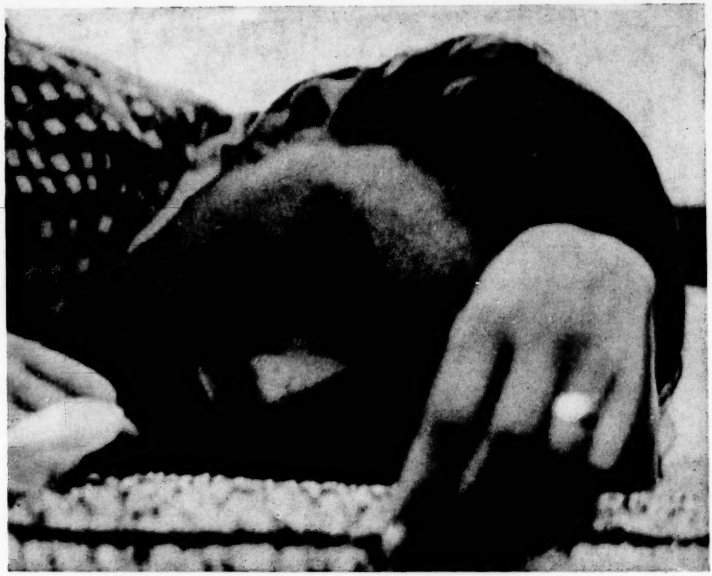

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RUPTURE OF THE HEART AFTER MYOCARDIAL INFARCTION*

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BOSTON

CARDIAC rupture with hemorrhage into the pericardium has long been recognized as a dramatic and rapidly fatal complication of myocardial infarction. Despite its invariably fatal termination, rupture of the heart has attracted the interest of physicians since its original description by Harvey[1] in 1647.

At the Mallory Institute, the pathological department of the Boston City Hospital, interest in this subject was renewed by the observation of several cases of cardiac rupture in rapid succession. This suggested an increased frequency of this complication and presented the possibility that newly introduced methods of therapy favor cardiorrhexis.

It was thus considered that a clinical re-evaluation of this entity would prove beneficial, emphasizing the relation between the current therapy of myocardial infarction and rupture of the heart.

REVIEW OF THE LITERATURE

The problem of rupture of the heart has been studied in several ways. These include incidence and recognition, association with underlying heart disease, timing of rupture after myocardial infarction, association with hypertension, relation to exertion and relation to therapy. The earlier literature[1-12] dealt primarily with isolated clinical and pathological reports that noted the rarity of cardiac rupture.

In recent years larger surveys have been compiled. The average frequency of heart rupture among routine autopsies in general hospitals is 0.35 per cent.[13-30] The incidence is higher among coroner's cases[15,26,28] since cardiorrhexis is a frequent cause of sudden death,[14] especially after myocardial infarction.[20,23,31,32] The incidence is also higher in mental institutions.[26,28,33,34]

The frequency of cardiac rupture has been noted[23] to rise as the incidence of myocardial infarction has increased. Among autopsies revealing a myocardial infarct, the average incidence of heart rupture is 4.4 per cent.[17-22,35-39] The incidence is, of course, always higher when only fresh infarctions are studied. Acute fatal myocardial infarctions are complicated by cardiac rupture in 8.9 per cent of cases.[19-28,32,36-43] Rupture occurs even more frequently in acute massive myocardial infarctions.

Although the pattern of death from cardiac tamponade is well known, few cases of external rupture of the heart have been diagnosed ante mortem.[10,-26,44-46] Specific findings are few and fleeting. Auscultatory findings have been noted in only three reports.[10,44,45]

Rupture of the infarcted interventricular septum, however, gives specific findings. An ante-mortem diagnosis has been reported many times.[20,23,26,27,47-65] The characteristic murmur and thrill associated with progressive right-sided heart failure after myocardial infarction establish the diagnosis. Septal rupture, however, is easily confused with rupture of a papillary muscle.[62-68]

The etiology of cardiac rupture has been widely studied. The association of coronary-artery disease and rupture of the heart had recently been recognized[5,69,70] when Winsor,[71] in 1880, and subsequently, Marie,[72] in 1896, first noted myocardial infarction to precede rupture of the heart. Krumbhaar and Crowell,[13] in 1925, by their extensive review of the literature, called attention to myocardial infarction as the leading underlying cause of cardiac rupture. This relation has been confirmed several times.[14,15,22-24,26,-31,33]

Various other causes of heart rupture have been noted. Acute[7,11,31,73-75] and subacute[15,75,76] bacterial endocarditis, either as myocardial abscesses[7,73,74] or as mycotic aneurysms,[75] brucella endocarditis,[77] syphilis,[8,12,13,15,31,78,79] tuberculosis[13,80] and echinococcus cysts[13] have all been reported as causing rupture of the heart. Several cases have also been noted[13,81-83] as a

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rare[84] complication of cardiac tumors. Although cardiorrhexis has been reported to occur through a myocardial aneurysm,[13,15,30,32,85-88] this rarely happens.[15,21,23,26,38,89] Death from cardiac aneurysm is usually by heart failure.

Trauma has been stressed as a cause of rupture of previously normal hearts.[88,90-100] This is an infrequent result of severe nonpenetrating wounds of the chest[90,99,101] and very rarely results from trauma to remote parts of the body, such as the legs, by suddenly increasing intracardiac pressure.[90,102]

Furthermore, recent studies[23,26,37] have associated cardiac rupture with the fresh myocardial infarcts in which fibrosis is lacking. Thus, a heart may rupture through an acutely diseased or, occasionally, through a healthy myocardium, but rarely through a fibrosed one.

About 90 per cent of ruptures occur through the external ventricular wall.[13,31] Eighty cases of atrial rupture have been reported.[97] This lesion has never been diagnosed ante mortem. The causes of atrial rupture are the same as those of ventricular rupture, but trauma predominates. About 100 cases of rupture of the interventricular septum have been reported,[60-64] a third of which have been diagnosed ante mortem.[20,23,26,27,47-65] This lower incidence is thought to be due to the more anastomotic coronary circulation in the interventricular septum.[48] Rupture of a papillary muscle is even less common,[103] and this diagnosis is rarely made. The murmur of a ruptured papillary muscle is often located more laterally and is not associated with a thrill.[66-68,103] The pathogenesis of this lesion is excessive strain on the necrotic muscle, causing left-sided heart failure.[68,104] Survival is occasionally prolonged.[67]

Cardiac rupture occurs through the anterior ventricular wall three times as frequently as through the posterior wall.[13,31] Over 95 per cent of external ventricular ruptures involve the left ventricle.[24] Various atypical locations and combinations of heart ruptures have been reported.[7,9,98,100,105-108]

The size of ruptures[13,14,26,48] ranges from a few millimeters to several centimeters.

The majority of cardiac ruptures occur by dissection.[33,109,110] The blow-out type is less commonly seen. The heart may rupture from the force of its own contractions, or it may burst from the weight of

TABLE 1. *Incidence of Rupture of the Heart among Autopsies.*

	Source of Data	Year	Cases of Rupture	Autopsies
General hospitals:				
	Krumbhaar & Crowell[13]	1925	7	16,000(0.04%)
	de la Chapelle[14]	1926	4	1,525(0.26%)
	Buckley[30]	1928	3	1,330(0.23%)
	Benson et al.[15]	1933	13	4,657(0.28%)
	Salzmann[29]	1934	6	5,000(0.12%)
	Edmondson & Hoxie[23]	1942	72	25,000(0.29%)
	Friedman & White[19]	1944	10	2,967(0.34%)
	Foster[17]	1946	12	2,915(0.41%)
	Wartman & Hellerstein[21]	1948	7	2,000(0.35%)
	Cleland[28]	1948	12	6,000(0.20%)
	Diaz-Rivera & Miller[20]	1948	5	1,250(0.40%)
	Foord[25]	1948	33	3,173(1.03%)
	Wang et al.[22]	1948	23	7,018(0.33%)
	Rath & Price[18]	1950	9	3,041(0.30%)
	MacDonald & Bentley[16]	1951	8	1,636(0.49%)
	Oblath et al.[24]	1952	91	13,665(0.67%)
	Wessler et al.[26]	1952	19	1,641(1.16%)
	Goetz & Gropper[27]	1954	14	1,292(1.08%)
	Totals		348	100,110(0.35%)
Mental hospitals:				
	Beresford & Earl[35]	1930	31	2,374(1.3%)
	Stewart & Eaton[78]	1933	6	840(0.7%)
	Petersen[113]	1934	3	207(1.5%)
	Snyder[94]	1940	9	490(1.8%)
	Simburg[112]	1941	2	470(0.4%)
	Cleland[28]	1948	4	600(0.7%)
	Totals		55	4,981(1.1%)
Coroners' cases:				
	Benson et al.[15]	1933	27	2,112(1.3%)
	Cleland[28]	1948	8	250(3.2%)
	Rabson[116]	1948	24	2,030(1.2%)
	Totals		59	4,392(1.3%)
Patients with coronary-artery disease:				
	Yater et al.[35]	1951	15	950(1.58%)
Present study:				
	Maher et al.	1956	21	1,928(1.09%)

TABLE 2. *Cases of Cardiac Rupture among Myocardial Infarctions.*

Source of Data	Year	Cases of Rupture	Myocardial Infarcts
Parkinson & Bedford[39]	1928	5	83(6.0%)
Bean[38]	1938	17	300(5.7%)
Friedman & White[19]	1944	10	270(3.7%)
Foster[17]	1946	12	234(5.1%)
Wartman & Hellerstein[21]	1948	6	150(4.0%)
Diaz-Rivera & Miller[20]	1948	5	147(3.4%)
Wang et al.[22]	1948	23	556(4.1%)
Rath & Price[18]	1950	9	142(6.3%)
Zinn & Cosby[27]	1950	34	679(5.0%)
Yater et al.[35]	1951	15	454(3.3%)
Waldron et al.[36]	1954	40	955(4.2%)
Totals		176	3,970(4.4%)

the interventricular pressure.[33,109] The modes of death are cardiac tamponade and ventricular fibrillation.[13,33,34]

Death is immediate in external ventricular rupture,[23] unless the perforation is very small. One patient is known to have survived for three weeks.[46] Prolonged survival more often accompanies atrial rupture,[82,97] or rupture of the interventricular septum.[49-52,63,65,111] A case with survival for five years after septal rupture has been reported.[65]

The timing of myocardial infarcts, as studied by Mallory, White and Salcedo-Salgar,[40] demonstrated rupture of the heart as an early complication of myocardial infarction. The authors pointed out that the heart is most likely to rupture when necrotic tissue is most abundant — that is, during the second to the sixth day after infarction. The observations of many others have confirmed the propensity of the heart to rupture during the first two weeks after infarction.[17,-19,23,24,43,110] Wessler et al.[26] explain the wider clinical range of time in which heart rupture occasionally occurs by the dynamic nature of myocardial infarction — that is, new areas of necrosis occurring simultaneously with areas of healing.

The association of hypertension and cardiac rupture is well recognized.[14,17-20,23,26,34,40,43,54,78,110] In the presence of normal heart valves, intracardiac pressure rises proportionately to arterial blood pressure, increasing the likelihood of cardiac rupture.[40]

The relation between exertion and cardiac rupture has long been recognized.[14,15,23,33,34] Cardiac rupture has also been frequently noted in mental institutions.[3,4,13,28,33,34,78,101,112,113] The study of Jetter and White[114] revealed a 73 per cent incidence of heart rupture among belatedly diagnosed and unrecognized myocardial infarcts in mental institutions, proving the higher frequency of cardiorrhexis after exertion. The pathogenetic significance of these relations has not been fully established.

In their recent review of the clinicopathological background Wessler et al.[26] did not find a significant increase in the incidence of cardiorrhexis attributable to any of the usual therapeutic measures for myocardial infarction. Such cases have been reported more frequently, however, in association with the use of anticoagulants.[36,115]

Material and Methods

The material was taken from the records of the Boston City Hospital for the period from July 1, 1952, to June 30, 1954. During these two years more than 70,000 patients were admitted to this hospital. In the fatal cases in this span, 1928 autopsies were performed. Recent or healing myocardial infarction was found in 183 cases, or 9.5 per cent of the autopsies. Clinical histories were obtained on 178 of these 183 cases. The most common severe complications of the myocardial infarcts were shock and congestive heart failure. The incidence of ventricular fibrillation could not be accurately ascertained, but it did not appear to be rare. Extension of the infarction, cardiac rupture, pneumonia and embolic phenomena, particularly pulmonary and cerebral infarcts, were also frequently observed, emphasizing the value of attempting prophylactic and therapeutic measures to control these complications.

In this two-year period there were 21 cases of cardiac rupture among the 183 recent myocardial infarcts studied. In this work, rupture of the heart denotes a complete acquired defect through the muscular wall of one or more cardiac chambers. It includes perforation of the interventricular and interatrial septa. It does not include incomplete myocardial tears or rupture of the coronary arteries or veins, cardiac valves, papillary muscles, chordae tendineae or aorta.

TABLE 3. *Cases of Cardiac Rupture among Acute Fatal Myocardial Infarctions.*

Source of Data	Year	Cases of Rupture	Myocardial Infarcts
Parkinson & Bedford[39]	1928	5	51(9.8%)
Levine[32]	1929	9	46(19.6%)
Bean[38]	1938	17	114(14.9%)
Mallory et al.[40]	1939	8	72(11.0%)
Edmondson & Hoxie[23]	1942	72	865(8.3%)
Friedman & White[35]	1944	10	105(9.5%)
Mintz & Katz[41]	1947	5	46(10.4%)
Wartman & Hellerstein[21]	1948	6	111(5.5%)
Selzer[42]	1948	8	95(8.4%)
Wang et al.[22]	1948	23	267(8.6%)
Cleland[28]	1948	12	125(9.6%)
Diaz-Rivera & Miller[29]	1948	5	53(9.4%)
Foord[25]	1948	33	264(12.5%)
Howell & Turnbull[45]	1950	8	111(7.2%)
Zinn & Cosby[27]	1950	34	430(7.9%)
Oblath et al.[24]	1952	91	1,026(8.9%)
Wessler et al.[26]	1952	19	261(7.9%)
Waldron et al.[36]	1954	40	545(7.3%)
Goetz & Gropper[27]	1954	14	145(9.6%)
Totals		419	4,732(8.9%)
Present study:			
Maher et al.	1956	21	183(11.5%)

A hundred and seventy-eight cases were reviewed clinically, including all 21 cases of cardiac rupture. All the cases of rupture followed an acute myocardial infarction. Hypertension, shock, heart failure, exertion, age of the infarct and drug therapy are the main classifications under which the cases were clinically analyzed. Neither the duration of life after cardiorrhexis nor the site, type or size of the rupture was reviewed. These considerations have been well

studied in the past. There were no cases of atrial rupture in this series. There were 2 cases of septal rupture, 1 of which was diagnosed ante mortem. A case of ruptured papillary muscle followed myocardial infarction, but was not included in our study.

Results

Incidence

In our series, cardiac rupture occurred in 21 cases among 1928 autopsies. The incidence of cardiorrhexis as a cause of death was thus 1.1 per cent. This compares with an average of 0.35 per cent in other series. There were 21 ruptures among 183 cases of acute myocardial infarction. The figure of 11.5 per cent is slightly higher than the average of 8.9 per cent in other reports. The incidence is shown in Tables 1, 2 and 3.

Age

The age span in our cases was fifty-five to ninety-two years, with a mean of sixty-nine and three tenths. These figures are in close agreement with those reported by other authors.[13-15,19,24,26,33,35] Cases in younger patients are more common with atrial rupture[97,117] and with other causes of cardiac rupture,[8,-13,88,91-94,102,118,119] especially trauma. Yater et al.[35] have shown that even in patients with coronary-artery disease, cardiac rupture is more common in the older age groups.

Sex

Of our 21 cases, 11 were males and 10 were females. Cardiac rupture has been previously noted[13,-26,37,38,110] as often in females as in males despite the prevalence of myocardial infarction in males.

Duration of Infarct

Twenty-six per cent of our patients died during the first day of the illness, 58 per cent during the first five days and 84 per cent during the first eight days after the onset of chest pain. The average duration of life was six and a half days.

The clinical duration of the infarct was not accurately determined in all cases. The group with questionable histories, however, did not differ in average duration from those with a definite onset. In some cases the clinical age of the infarct could not be determined.

Table 4 presents a review of the interval between infarction and rupture in several cases, including our own. In the cases reviewed, over 50 per cent of cardiac ruptures occurred in the first five days after myocardial infarction; rupture was not rare in the first twenty-four hours after infarction. Some of the larger series could not be used in this review because the interval was not reported specifically. Rupture of the heart, however, has been repeatedly noted to be an early complication of myocardial infarction, occurring frequently in the first four days of the illness.[17,19,23,24,38,43] Silent infarctions may explain the occurrence of cardiac rupture within the first twenty-four hours after the onset of chest pain.[43] Extension of necrosis of the myocardium concomitant with areas of healing may explain delayed rupture of the heart.

TABLE 4. *Interval between Infarction and Rupture.*

Source of Data	No. of Cases										
	1 day after infarction	2d day after infarction	3d day after infarction	4th day after infarction	5th day after infarction	6th day after infarction	7th day after infarction	8th day after infarction	9th day after infarction	10th day after infarction	11th day after infarction
Levine[32]	1	—	1	1	—	2	—	—	—	—	1
Mallory et al.[40]	1	1	1	—	—	2	1	—	1	—	—
Bean[28]	1	3	1	2	1	—	3	1	—	—	—
Friedman & White[19]	3	2	—	2	—	—	1	—	1	—	—
Foster[17]	2	4	3	—	2	1	—	—	—	—	—
Wessler et al.[26]	—	2	—	3	3	2	1	2	1	2	1
Rath & Price[15]	1	—	2	1	1	—	—	—	1	1	—
Diaz-Rivera & Miller[20]	—	1	1	—	—	1	1	—	—	—	—
Bond et al.[42]	1	1	2	—	—	—	—	—	1	—	—
Howell & Turnbull[43]	1	1	1	2	—	—	—	—	—	1	1
Segall & Sharp[64]	—	—	—	1	1	1	—	—	—	—	—
Gans[110]	—	2	2	—	—	—	—	—	1	—	—
Present study	5	—	—	3	3	1	1	3	—	1	—
Totals	16	17	14	15	11	10	8	6	6	5	3

Old Infarction

Of our 183 cases of acute myocardial infarction, 66 also showed an old, healed myocardial infarct at autopsy. Two of these hearts, or 3.0 per cent, ruptured. The remaining 117 patients, including 19 with cardiac ruptures, had only acute or healing myocar-

dial infarctions. The incidence of heart rupture among patients dying from their first infarction was thus 16.2 per cent. This agrees with previous observations[23,26,37] that myocardial fibrosis is much less common in infarctions that terminate in cardiac rupture.

Wessler, Zoll and Schlesinger[26] found that the common pathologic substrate for rupture of the heart is as follows: fresh coronary occlusion; recent myocardial infarction; a myocardial infarction that is transmural; a myocardial infarction that is poorly supplied with collateral vessels; and a myocardial infarction in which fibrosis is absent in at least one area.

diuretic died of rupture of the heart. The 20.7 per cent incidence here represents a significant difference, confirming the myocardial-fibrosis and heart-failure statistics.

Antibiotics

In the present study, 68 patients received one or more antibiotics. Four of this group, or 6.0 per cent, died of cardiac rupture. Of the 110 who received no antibiotic during their hospitalization, 17 patients, or 15.5 per cent, died of rupture of the heart. The lower incidence in the antibiotic-treated group suggests two possibilities. The use of these drugs implies the pres-

TABLE 4 *(Concluded).*

SOURCE OF DATA	NO. OF CASES									
	12TH DAY AFTER INFARCTION	13TH DAY AFTER INFARCTION	14TH DAY AFTER INFARCTION	16TH DAY AFTER INFARCTION	17TH DAY AFTER INFARCTION	19TH DAY AFTER INFARCTION	21ST DAY AFTER INFARCTION	23D DAY AFTER INFARCTION	28TH DAY AFTER INFARCTION	35TH DAY AFTER INFARCTION
Levine[22]	—	—	2	—	—	—	—	—	—	1
Mallory et al.[40]	1	—	—	—	—	—	—	—	—	—
Bean[28]	2	1	—	1	—	—	—	—	—	—
Friedman & White[19]	—	—	1	—	—	—	—	—	—	—
Foster[17]	—	—	—	—	—	—	—	—	—	—
Wessler et al.[26]	—	—	—	—	—	1	1	—	—	—
Rath & Price[18]	1	—	—	—	—	—	—	1	—	—
Diaz-Rivera & Miller[20]	—	1	—	—	—	—	—	—	—	—
Bond et al.[42]	—	—	—	—	—	—	—	—	—	—
Howell & Turnbull[43]	1	—	—	—	—	—	—	—	—	—
Segall & Sharp[44]	1	—	—	—	—	—	—	—	—	—
Gans[110]	1	—	—	—	—	—	—	—	—	—
Present study	—	—	—	—	1	—	—	—	1	—
Totals	7	2	3	1	1	1	1	1	1	1

There were no cases of myocardial aneurysm as the underlying cause of cardiac rupture in our study. This agrees with previous observations.[17,19,22,24,26,37,38,89]

Heart Failure

In this series, 123 patients had at least minimal evidence of congestive heart failure. Seven of these hearts, or 5.7 per cent, ruptured. Of the 50 hearts not in failure, 14 (28 per cent) ruptured. The significant difference in these groups correlates with the findings of Wessler et al.,[26] who noted heart failure in a twentieth of their patients with rupture, a third of those with other fatal myocardial infarctions and a twelfth of the survivors of an infarction.

Diuretics

Eighty-six of the patients with heart failure received one or more diuretics, usually a mercurial preparation, aminophylline or ammonium chloride. Two of these 86, or 2.3 per cent, sustained cardiac rupture. Nineteen of the 92 patients who did not receive a

ence of complications, which in themselves may add quantitatively to the mortality of myocardial infarction, reducing the percentage of deaths from all other complications. Moreover, many of the antibiotic-treated patients were in congestive heart failure, in which the incidence of cardiorrhexis is low.

Digitalis

Digitalis was given to 57 patients because of either acute pulmonary edema or various types of arrhythmia. Six of these patients (10.5 per cent) had cardiac rupture. In 15 of 83 patients who received no digitalis during their hospitalization, or 18.1 per cent, rupture of the heart occurred. Among the 38 patients who were placed on maintenance digitalis there were no cases of rupture of the heart. The significantly lower incidence in the latter group disagrees with the old concept that digitalis may precipitate cardiac rupture.[110]

Thus, in our series of 183 acute myocardial infarctions, the incidence of cardiac rupture was lower among the patients who showed an old infarction at

autopsy or congestive heart failure clinically or were treated with diuretics, antibiotics or maintenance digitalis. These figures are summarized in Table 5.

Hypertension

Although, for various reasons, clinical data on arterial blood pressure were not always a reliable determination in our series, the patients were classified as normotensive, hypertensive and markedly hypertensive. Normotensive patients were those whose blood pressure was between 100 systolic, 60 diastolic, and 140 systolic, 90 diastolic. Of the 66 in this group, 5 cases, or 7.6 per cent, were complicated by rupture. Eighty-six patients with blood-pressure readings over 140 systolic, 90 diastolic, were considered to be hypertensive. In this group cardiac rupture developed in 13, or 15.1 per cent. Patients with blood-pressure levels over 165 systolic, 100 diastolic, were considered markedly hypertensive. There were 49 such patients, 8 of whom (16.2 per cent) died of rupture of the heart. The number of cases in this study was not sufficient to demonstrate a statistically significant difference between the incidence of heart rupture in normotensive and hypertensive patients.

TABLE 5. *Influence of the Presence of Heart Failure and Its Treatment.*

GROUP		NO. OF INFARCTIONS	NO. OF RUPTURES	PERCENTAGE
All patients		183	21	11.5
Cases reviewed clinically		178	21	11.8
Old myocardial infarct:				
	Present	66	2	3.0
	Absent	117	19	16.2
Heart failure:				
	Present	123	7	5.7
	Absent	50	14	28.0
Diuretic:				
	Given	86	2	2.3
	Not given	92	19	20.7
Antibiotic:				
	Given	68	4	6.0
	Not given	110	17	15.5
Digitalis:				
	Given	57	6	10.5
	Digitalization maintained	38	0	0.0
	Not given	83	15	18.1

The relation between hypertension and heart rupture has been noted by many other authors,[14,17,19,23,24,26,36,40,41,43,54,78,110,114] the incidence in some reports being twice as common as in control infarctions. It has also been shown[23] that the higher the blood pressure, the smaller the infarction has to be to produce rupture of the heart. Furthermore, patients who maintain persistent hypertension after myocardial infarction, rather than undergo the usual fall in blood pressure, are even more likely to die of rupture of the heart.[23,24,26] Our figures on hypertension are shown in Table 6.

Shock

Although shock is well recognized as a frequent complication of myocardial infarction, the relation between postinfarction shock and cardiac rupture has not been exhaustively studied.

Any patient who had a precipitous drop in blood pressure below a systolic level of 100 at least an hour before death was considered as being in a state of hypotension. There were 87 such patients, most of them actually in shock, with 12 (13.8 per cent) ruptures of the heart among them. Among the 88 who were not hypotensive there were 9 cardiac ruptures, or 10.2 per cent.

Over 50 per cent of acute fatal myocardial infarctions are complicated by shock,[38,120-122] which is a well known sign of poor prognosis.[41,121-124] After myocardial infarction, the performance of the left ventricle in dogs is as good during shock as with normal blood pressure.[125] If shock is not prolonged, cardiac output remains adequate despite the fall in the interventricular pressure[126] and the decreased collateral intercoronary circulation.[127] The state of shock accompanying myocardial infarction unquestionably deserves aggressive and prompt treatment.

Levarterenol

In our series, 47 patients were treated with levarterenol (Levophed), or l-nor-epinephrine. Seven of these patients (14.9 per cent) died of cardiac rupture. Among the 131 who did not receive levarterenol, 14 hearts, or 10.7 per cent, ruptured.

TABLE 6. *Rupture of the Heart in Relation to Arterial Blood Pressure.*

GROUP	NO. OF INFARCTIONS	NO. OF RUPTURES	PERCENTAGE
Total patients with known blood pressure	152	18	11.8
Normotensive patients	66	5	7.6
Hypertensive patients	86	13	15.1
Markedly hypertensive patients	49	8	16.3

There have been many favorable reports on the use of levarterenol in the treatment of shock.[128-140] The results have been less gratifying than in postinfarction shock in other conditions. The drug causes constriction of arteries, arterioles, veins, venules and capillaries, elevating systolic, diastolic and mean blood pressure.[140,141] It is also characterized by a low toxicity, ease of administration and control, rapid onset and short duration of action. Levarterenol raises the blood pressure without a significant change in cardiac output, or coronary circulation, and yet with a tendency to produce myocardial irritability.[130,141-143] Table 7 shows the results in the treatment of myocardial infarction.[128-139] Despite a pressor effect in 80 per cent of cases of postinfarc-

tion shock treated with levarterenol, the survival rate is usually only about 40 per cent. Cardiac rupture has been noted[132,135] several times in these reports despite the paucity of autopsy data.

It has been shown that the larger the infarction, the greater the accompanying drop in blood pressure.[23] But with large infarctions, rupture of the heart is common not only in patients with hypertension but also in those with normal blood pressure. Therefore, one must be careful not to raise the blood pressure excessively after myocardial infarction by the injudicious use of drugs such as levarterenol. Hellerstein and Brofman[144] recommend, as an end point for systolic blood pressure, 100 in normotensive and 120 in hypertensive patients.

Although in our series, cardiac rupture was more frequent in the group treated with levarterenol, the difference is not significant. Moreover, these figures correlate closely to those for untreated shock. From our study, this drug could not be regarded as a cause of increased cardiac rupture. It is of interest that 1 case of rupture of the interventricular septum was diagnosed before levarterenol therapy; this septal rupture could not be related to the drug.

Intracardiac Administration of Epinephrine

Intracardiac administration of epinephrine was given terminally in 20 cases, 3 of them deaths from cardiac rupture. Rupture in 15 per cent of this group may demonstrate the error of a small series or perhaps reflects the dramatic symptoms associated with sudden death by cardiac rupture. It is not considered to represent an effect of the drug or needle puncture of the heart. The figure of 11.4 per cent in the control group represents 18 cardiac ruptures among 158 cases of myocardial infarctions.

Exertion

After myocardial infarction, exertion is known to endanger life, rupture being a prominent hazard.[14,15,23,26,114] Influenced by the work of Levine,[145] the current trend in therapy of myocardial infarction is toward a bed-and-chair regimen, rather than rest strictly in bed. Our study of the relation between exertion and cardiac rupture was not, therefore, directed toward reconfirming the observations of others. It was rather a study of the effect of any deviation from strict bed rest on the occurrence of rupture.

In evaluating the maintenance of strict bed rest, we considered bed rest not maintained if the patient was dead on arrival, was noted to be out of bed, had a convulsion that was not a terminal event or was under ambulatory bathroom privileges or bed-and-chair orders. It was realized that some patients may have violated strict bed rest unnoticed or without notation; nevertheless, these patients had to be considered among those who maintained strict bed rest. In the out-of-bed group there were 45 patients, in 6, or 13.3 per cent, of whom rupture developed. On the other hand, cardiorrhexis occurred in 15 of the 133 patients in whom strict bed rest appeared to be maintained. The incidence in this control group was 11.3 per cent.

The lower mortality reported[145,146] in the myocardial infarcts treated by the bed-and-chair method should not be offset by a slightly higher incidence of heart rupture in the out-of-bed group in our series. The former treatment does not seem to have the hazards of unusual exertion. It appears unwise, however, to allow a greater scope of activity than that included in the usual method of bed-and-chair therapy.

TABLE 7. *Levarterenol in Shock Accompanying Myocardial Infarction.*

SOURCE OF DATA	TOTAL CASES	CASES WITH PRESSOR EFFECT	CASES WITH NO RESPONSE	CASES WITH SURVIVAL	CASES RESULTING IN DEATH
Griffith et al.[128]	30	19	11	—	—
Miller & Baker[129]	7	4	3	1	6
Livesay & Chapman[130]	6	5	1	1	5
Miller et al.[131]	9	8	1	5	4
Sampson & Zipser[132]	30	27	3	16	14
Kurland & Malach[133]	14	9	5	4	10
Eckenhoff & Dripps[134]	20	—	—	7	13
Binder et al.[135]	25	23	2	8	17
Calenda et al.[136]	13	9	4	2	11
Gazes et al.[137]	7	7	0	6	1
Smith & Guz[138]	6	6	0	4	2
Moyer et al.[139]	14	12	2	6	8
Totals	181	129	32	60	91

It has been shown[147] that, in dogs, exertion soon after experimental myocardial infarction results in a thin scar, with aneurysmal bulging.

Since cardiac rupture is well recognized as an early complication of myocardial infarction, rest should be emphasized in the first few days of the illness — that is, during the period when the diagnosis may be uncertain. Exertion after painless myocardial infarction remains a problem in the prevention of cardiac rupture.

Anticoagulation

Since anticoagulation has a known mortality risk,[148] an increase in the incidence of heart rupture with subsequent hemopericardium might be related to anticoagulation. Effective anticoagulation was accomplished in 13 of our patients, 3 of whom sustained rupture, an incidence of 23.1 per cent. It is noteworthy that one of these had a prothrombin time of 58 seconds on the day that rupture of the heart occurred.

Of the 32 cases in which anticoagulation was attempted, there were 6 ruptures, a frequency of 18.8

per cent. Fifteen of the 146 patients who received no anticoagulant had cardiac rupture; the incidence in this group is 10.3 per cent. There is no statistically significant difference between the two groups. It is noteworthy that anticoagulation was utilized more often in massive infarctions, but several patients died before reaching a therapeutic range of anticoagulation.

Dicumarol has no adverse effects on the myocardium of dogs, nor does it retard the healing process in experimentally produced myocardial infarctions.[149] Despite reports to the contrary,[18,26] anticoagulation has been noted to be associated with a striking increase in hemopericardium after myocardial infarction,[36,115] largely because of an increase in rupture of the heart. Waldron et al.[36] found cardiac rupture in 34 per cent of patients in a therapeutic range of anticoagulation, 55 per cent with excessive anticoagulation and 25 per cent in patients below the therapeutic range of anticoagulation.

The incidence of thromboembolic phenomena accompanying myocardial infarction is high.[21,32,38,42,-120,150,151] This complication denotes a poor prognosis.[21,42,150] Although anticoagulants minimize embolization,[151] caution must be emphasized in their use.

Miscellaneous Drugs

A consideration of the 2 cardiac ruptures among the 14 patients treated with procaine amide (Pronestyl) did not justify a conclusion. This was true also of 2 ruptures among 9 patients treated with quinidine. Wessler et al.[26] did not find a significant increase in the frequency of cardiac rupture related to quinidine usage. Intravenous administration of epinephrine and coramine, cardiac massage, the use of the cardiac pacemaker and other desperation measures were not attempted often enough even to begin an evaluation of these procedures. Heart rupture has recently been reported, however, during cardiac massage.[152]

Combination of Hypertension and Heart Failure

In our study the most significant differences noted were an increased rate of occurrence in hypertensive patients and a lower rate in those with myocardial fibrosis manifested clinically by congestive heart failure. When the cases were evaluated for this combination of factors, there were 25 hypertensive patients who were not in heart failure. Ten of these patients sustained rupture, a frequency of 40 per cent. Among the 50 normotensive patients in congestive heart failure, rupture of the heart occurred in 2, or 4 per cent.

Discussion

In the present study, descriptions of clinical findings were reduced to positive and negative statements. Although this is an oversimplification of the data, this shortcoming applied to both the cardiac ruptures and the control group and should not alter the results greatly. Our figures, however, are generally in accord with other recent studies. A summation of reports thus allows for a large cumulative survey.

Since cardiac rupture is found in 0.35 per cent of all autopsies and 9 per cent of acute fatal myocardial infarctions, this lesion should not be considered rare as it has been in the past.

The success of modern medicine has magnified the field of geriatrics. In turn, myocardial infarction and its complications, including rupture of the heart, are more frequently encountered as the general population advances in age. None of the methods of treatment of myocardial infarction analyzed in the present study could definitely be considered responsible for the recent higher frequency of cardiac rupture. It would be expected, however, that the injudicious use of levarterenol or anticoagulants or the abuse of the bed-and-chair regimen might result in rupture of the heart. A further evaluation of these procedures seems to be indicated.

Unlike other complications of myocardial infarcts, the art of prevention appears to be the only solution to the problem of cardiac rupture. Rest must be emphasized during the early period after infarction, when the diagnosis is being established. Hypertensive patients and those who have no evidence of heart failure in particular must be kept at rest if rupture is to be prevented.

Summary

Twenty-one hitherto unpublished cases of cardiac rupture are clinically analyzed. This report includes 2 cases of rupture of the interventricular septum, 1 of which was diagnosed ante mortem. These 21 cases occurred among 183 acute fatal myocardial infarctions and among 1928 routine autopsies in a general hospital. The incidence in our series is 11.8 per cent of recent myocardial infarctions and 1.1 per cent of all autopsies.

Heart rupture was less common in patients with evidence of an old myocardial infarction or congestive heart failure and in those treated with diuretics, maintenance digitalis or antibiotics. On the other hand rupture was more frequent in association with hypertension and exertion. The increased frequency of heart rupture in association with the presence of shock or the use of levarterenol, anticoagulation or the armchair treatment of myocardial infarction was not significant. Half the ruptures in our series occurred in the first five days after myocardial infarction.

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RHEUMATOID SPONDYLITIS AND AORTIC INSUFFICIENCY*

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HEART disease associated with rheumatoid spondylitis (Marie–Strümpell arthritis) has been a subject of interest for many years.[1-17] Pericarditis,[6,7,10,13,15-17] myocarditis[3,12,16,17] and particularly endocarditis with valvulitis[1-7,9-13,15-17] have been reported. Involvement of the mitral and aortic valves has been described, but aortic-valve disease, particularly with aortic insufficiency, is apparently more common.[10,11,13,16-18] Conduction disturbances, either as isolated defects or in conjunction with other evidence of heart disease, have also been observed.[8,10,11,14] It has been stated that the heart disease in rheumatoid spondylitis characteristically follows an episode of acute polyarthritis,[1-3,10,11] is more common in patients in whom chronic peripheral rheumatoid arthritis develops with the onset of the spondylitis[1,9,13,14] and is usually benign.[5,10,11,14] Recently, one group of investigators has observed that the disease may be fatal.[17] Many have believed that cardiac disease associated with rheumatoid spondylitis is due to coincidental rheumatic fever[4,7,10,11] whereas others think that the clinical and pathological features are distinct enough, to exclude rheumatic fever and syphilis as a cause.[12,13,-16-18] The similarity of the lesions in the root of the aorta to syphilitic aortitis has been noted and discussed.[12,13,15,17,18]

Since rheumatoid spondylitis itself is relatively uncommon, not many cases with associated heart disease have been reported or available for study. During the past several years we have had the unusual opportunity of studying a large number of patients with aortic insufficiency who were being evaluated for surgical correction of this lesion. Surprisingly enough, rheumatoid spondylitis was present in 5 per cent of the first 100 seen. These cases illustrate the association of rheumatoid spondylitis and aortic insufficiency and present some unusual features.

CASE REPORTS

CASE 1. A 52-year-old man had had 3 episodes of back pain at the ages of 11, 19 and 23. He contracted gonorrhea 3 times as a young man and related transient arthritis of his ankles and toes to these episodes. A "calcified poker spine" was diagnosed at the age of 30. He fractured his cervical spine 2 years before admission and was left with residual stiffness and limitation of motion. Recent episodes of severe pain in the right shoulder had responded to diathermy. Two years before admission palpitation, prominent arterial pulsations, dyspnea on exertion, orthopnea and drenching perspiration were noted. In addition, heart murmurs and cardiomegaly were discovered, and he was digitalized. Because of progressive symptoms he retired from his occupation of telegraph operator. There was no history of definite rheumatic fever, syphilis, iritis, pericarditis, angina or hemoptysis.

Physical examination showed a well developed man in no acute distress. The lungs were clear. The heart was enlarged, the cardiac impulse extending to the anterior axillary line, with the point of maximum impulse in the 6th intercostal space. The pulmonic 2d sound was louder than the aortic, and the 1st mitral sound was not accentuated. There was a Grade 2 harsh aortic systolic murmur and a Grade 3 aortic blowing decrescendo diastolic murmur heard best along the left sternal border. At the apex there was a Grade 2 high-pitched systolic murmur, a Grade 3 diastolic rumble and a ventricular diastolic gallop. The liver edge was felt 2 fingerbreadths below the right costal margin. There was no dependent edema. The peripheral vascular signs of severe aortic insufficiency were present. There was accentuation of dorsal kyphosis and loss of lumbar lordosis, with a poker spine and generally diminished range of motion. A cervical scoliosis to the right was present. There was no evidence of peripheral arthritis.

The blood pressure was 160/40-0 in the arms and 280/40-0 in the legs.

The hematocrit was 40 per cent, and the sedimentation rate 42 mm. per hour; serologic tests were negative. An electrocardiogram showed 1st-degree atrioventricular block, with a PR interval of 0.38 second and hypertrophy of the left ventricle. Radiologic examination revealed marked enlargement of the left ventricle, with prominent rocking ventricular and aortic pulsations. The esophagus was displaced posteriorly in the region of the left ventricle. The aorta was slightly dilated, elongated and tortuous. There was calcification of the vertebral longitudinal ligaments of the thoracolumbar spine, with bamboo formation, osteoporosis and indistinct intervertebral articulations. Because of severe aortic insufficiency, the Hufnagel aortic plastic valve was inserted into the 1st part of the descending aorta. The postoperative course was uneventful. On readmission to the hospital 1 month later for evaluation, the patient had improved symptomatically, and the heart had decreased slightly in size. Twenty months after operation he suddenly died in another town, where an autopsy was performed.¶

The heart weighed 930 gm. and was generally hypertrophied. The myocardium was firm and brown. The left ventricle was 4 cm. thick at the base and 1 cm. thick at the apex. The wall of the right ventricle measured 1 cm. and was of fairly uniform thickness. The aortic valve was 8.5 cm. in circumference and appeared homogeneous, without irregularity or obliteration of the commissures. The leaflets were considerably shortened and measured 1.2 cm. in length at the middle of the cusps. They were thickened, especially along the free edge, where there was some rolling. At the base of the valve marked fibrosis, with thickening, extended into the annulus. The mitral valve was 9 cm. in circumference and appeared normal. The coronary ostia and vessels were not remarkable. There was mild atherosclerosis of the aorta. Microscopical examination revealed whorled masses of hyalinized collagenous tissue in the free edge, base and annulus of the aortic valve. There were a few tiny vessels in this hyalinized tissue, and scattered lymphocytes surrounded these at the valve base. There was myocardial hypertrophy. No Aschoff bodies were seen in many sections.

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It was the pathologist's opinion that these findings represented chronic rheumatic heart disease with aortic valvulitis and insufficiency.

This patient with advanced rheumatoid spondylitis and severe aortic insufficiency died suddenly twenty months after cardiovascular surgery. *Although the spondylitis began at an early age, the heart disease did not manifest itself until late in life.* The apical diastolic murmur was an Austin-Flint murmur since post-mortem examination did not reveal mitral stenosis. We have observed that in most patients with severe free aortic insufficiency on a rheumatic basis, an apical diastolic murmur is usually an Austin-Flint murmur rather than one of mitral stenosis.[19,20]

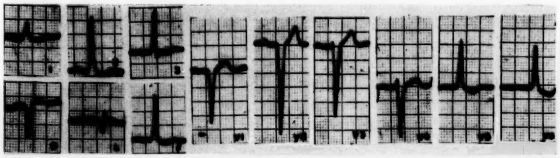

FIGURE 1. *Electrocardiogram in Case 2, Showing First-Degree Atrioventricular Block (PR Interval of 0.24 Second) and Hypertrophy of the Left Ventricle.*

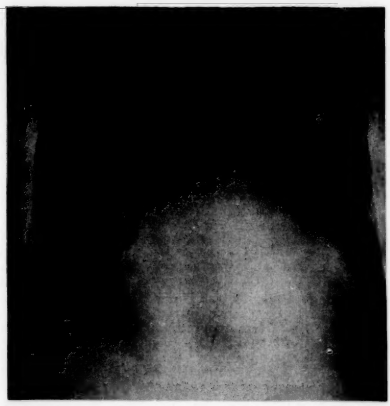

FIGURE 2. *Roentgenogram in Case 2, Showing Enlargement of the Left Ventricle.*

CASE 2. A 48-year-old retired baker stated that at 12 years of age he had been put to bed for 2 months with acute polyarthritis. He was asymptomatic until the age of 41, when a chronic cough, occasional hemoptysis, dyspnea on exertion, easy fatigability and slight ankle edema developed. These symptoms progressed, and 1 year later he had an acute episode of nocturnal dyspnea. Because of symptoms of congestive heart failure he limited his activities, and he did fairly well until he suffered a "strained back" after an accident. Subsequently, he had progressive pain and stiffness of the lower spine that did not benefit from radiation therapy. By the age of 45 the symptoms of congestive heart failure and the spinal arthritis had progressed to such an extent that he was unable to work. For the last 2 years he had noted drenching perspiration. He had been confined to bed for 18 months in spite of intensive medical therapy. There was no history of syphilis, iritis, pericarditis or angina.

Physical examination showed a well developed man in no distress. There were Grade 1 arteriosclerotic changes in the retinal arterioles. The lungs were clear. The heart was enlarged, the border of dullness extending to the anterior axillary line with the point of maximum impulse in the 6th intercostal space. The pulmonic 2d sound was louder than the aortic, and the 1st mitral sound was not accentuated. There was a Grade 3 aortic harsh systolic murmur and a Grade 4 blowing decrescendo diastolic murmur heard best along the left sternal border. At the apex there was a Grade 3 harsh systolic murmur, a Grade 3 rumbling dias-

FIGURE 3. *Roentgenogram in Case 2, Showing Complete Obliteration of the Sacroiliac Joints and Bambooing of the Spine.*

tolic murmur and a ventricular diastolic gallop. The liver edge was felt 4 fingerbreadths below the right costal margin. There was no dependent edema. The peripheral signs of severe aortic insufficiency were present. There was an ac-

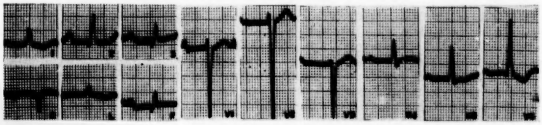

FIGURE 4. *Electrocardiogram in Case 5, Showing First-Degree Atrioventricular Block (PR Interval of 0.36 Second), with Hypertrophy of the Left Ventricle and an Old Diaphragmatic Infarction.*

centuated dorsal kyphosis, with loss of lumbar lordosis. Limitation of spinal motion extended to the cervical region. A bony prominence in the lumbosacral region was quite tender. The leg muscles were weak and atrophied.

The blood pressure was 130/44 in the arms and 140/54 in the legs.

The hematocrit was 35 per cent, and the sedimentation rate 34 mm. per hour; serologic tests were negative. An electrocardiogram showed 1st-degree atrioventricular block with a PR interval of 0.24 second, hypertrophy of the left ventricle and multifocal ventricular premature contractions (Fig. 1). Radiologic examination revealed considerable enlargement of the left ventricle, with a prominent rocking ventricular and aortic pulsation (Fig. 2). There was moderate dorsal kyphosis and calcification of the spinal longitudinal ligaments in the thoracolumbar region, with bamboooing and generalized osteoporosis. Narrowing and irregularity of the intervertebral articulations in the lumbar spine and complete obliteration and bony fusion of the sacroiliac joints were present (Fig. 3). In the hospital the patient was treated conservatively for his heart disease and rheumatoid spondylitis, and improved. On the 11th hospital day he died suddenly.

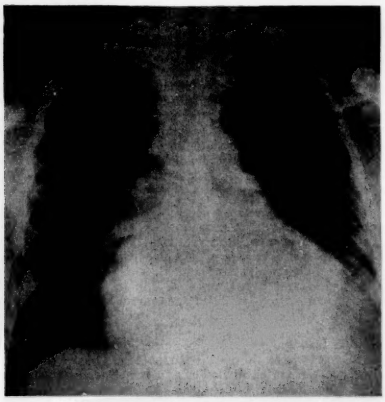

FIGURE 5. *Roentgenogram in Case 5, Showing Enlargement of the Left Ventricle.*

At autopsy, performed 6 hours after death, the heart weighed 770 gm. The parietal pericardium appeared normal, and the visceral layer showed small, irregular milk spots. There was general enlargement, with dilatation and hypertrophy, particularly of the left ventricle, the wall of which was 15 mm. thick; the right ventricle was 6 mm. thick. The myocardium was soft, flabby and brownish pink. There was no valvular abnormality except for the aortic valve, the cusps of which were greatly thickened, with a dense band along the free edge. The commissures were normal. The valve ring measured 8.5 cm. in circumference and admitted 2 fingers. The coronary ostia and vessels were normal. There appeared to be minimal atherosclerosis, with fine longitudinal ridges in the thoracic and abdominal

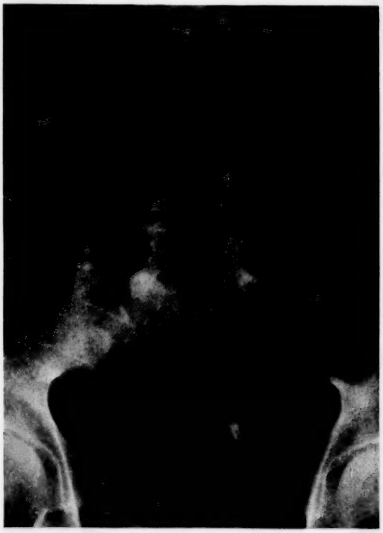

FIGURE 6. *Roentgenogram in Case 5, Showing Extensive Rheumatoid Spondylitis of the Sacroiliac Joints, Symphysis and Spine.*

aorta, where it was most pronounced, extending to the iliac arteries. Microscopical examination of the pericardium was negative. In the myocardium there was hypertrophy of the fibers, which were widely separated owing to marked interstitial edema and strands of fibrous tissue. There was occasional perivascular fibrosis and edema in the myocardium. There was slight thickening and hyalinization of the mitral-valve cusps, with mild vascularization at the base of the valve. At the root of the aorta, all the layers were greatly scarred and thickened by hyalinized fibrous tissue. There were several deposits of calcium in the intima. The elastic fibers of the media were disrupted and dis-

organized into small, irregularly shaped clusters by the fibrous tissue. This process of fibrosis extended into the adventitia and reflected pericardium over the aortic root, where there were small numbers of mononuclear cells and thick-walled vessels. The aortic leaflet was extensively hyalinized. Aschoff nodules were not observed in several heart sections. Examination of the aorta, except at the root, revealed areas of mild atherosclerosis. There was moderately severe sclerosis of the proliferative and hyaline type in the pulmonary arteries and arterioles, with parenchymal changes of severe chronic passive congestion. There was mild arteriosclerosis in the kidneys, pancreas and suprarenal vessels. Severe bilateral pulmonary emphysema and edema were present. There was chronic passive congestion of the liver, kidneys and pancreas. The skeletal system was not examined.

The findings were considered to be consistent with chronic rheumatic heart disease and aortic valvulitis and insufficiency.

This sudden death occurred while the patient was being evaluated for surgery. It has been noted that sudden death is common in patients with severe aortic insufficiency.[19,20] Although he denied symptoms of rheumatoid spondylitis before the accident five years previously, it was the opinion of the rheumatologist and radiologist that his disease was between ten and twenty years old. *He was the only patient in this report with a history of rheumatic fever.* Autopsy revealed chronic rheumatic heart disease with aortic insufficiency, but no mitral stenosis. Since the electrocardiogram on admission indicated multifocal premature ventricular contractions, it is postulated that the sudden death was probably due to ventricular fibrillation.

TABLE 1. *Data in 5 Cases of Rheumatoid Spondylitis and Aortic Insufficiency with Similar Features.*

Case No.	Age	Duration of Spondylitis	Duration of Heart Disease	History of Peripheral Rheumatoid Arthritis	History of Pericarditis	History of Iritis	History of Rheumatic Fever	Severe Arthritis of Ilium and Entire Spine	Recent Therapy for Rheumatoid Spondylitis
	yr.	yr.	yr.						
1	52	31	2	?	No	No	No	Present	Yes
2	48	10-20	6	No	No	No	Yes	Present	Yes
3	43	18	9	Yes	No	Yes	No	Present	Yes
4	61	26	10	No	No	No	No	Present	Yes
5	45	16	7	No	No	No	No	Present	Yes
Average	49	23	7						

CASE 3. A 43-year-old man had had several episodes of spontaneous epistaxis at the age of 10. When 21 years old he had gonorrhea. At the age of 25 he had an appendectomy complicated by a wound infection. This was immediately followed by a severe inflammatory arthritis of the lower spine, hips, knees, ankles, toes and thumbs and was accompanied by an anemia. He was hospitalized and received typhoid therapy, physiotherapy and later radiation of the spine. The peripheral joint symptoms subsided in a few months, but the spinal complaints persisted for over a year and he was left with some residual stiffness and occasional pain in the lumbosacral area. During an Army preinduction physical examination at the age of 33, the blood pressure was recorded as 120/80. One year later he fainted during a long march and was hospitalized, and a diagnosis of aortic insufficiency was made. At that time, the blood pressure was 140/40, and he noted prominent arterial pulsations for the 1st time. For several years before admission he again suffered from intense intermittent pain and stiffness in the lower back, with recent involvement of the cervical spine. During the past 6 months he had been incapacitated with rheumatoid spondylitis, and an associated anemia had been treated with 4 small blood transfusions. Phenylbutazone and further radiation to the spine were followed by only slight improvement. Ten months before admission, progressive failure, drenching perspiration, dyspnea on exertion and slight ankle edema developed. Seven months later an episode of acute pulmonary edema followed a blood transfusion. Recently, he had been receiving intensive cardiac therapy in addition to aspirin for the back pain. There was no history of rheumatic fever, syphilis, pericarditis, hemoptysis or angina. He had had iritis on the right at the age of 31 and on the left 3 months before admission.

Physical examination showed a thin, pale, alert man who assumed bizarre positions in bed to seek relief of back pain. The lungs were clear. The heart was enlarged, the border of dullness extending to the anterior axillary line, with the point of maximum impulse in the 6th intercostal space. The pulmonic 2d sound was louder than the aortic. The 1st mitral sound was not accentuated. There was a Grade 2 aortic harsh systolic murmur and a Grade 4 aortic blowing decrescendo diastolic murmur heard best along the left sternal border. At the apex there was a Grade 3 high-pitched systolic murmur, a Grade 3 rumbling diastolic murmur and a ventricular diastolic gallop. The liver was not enlarged. There was no dependent edema. The peripheral vascular signs of severe aortic insufficiency were present. There was a poker spine and loss of lumbar lordosis, limitation of motion of the thoracolumbar region and bilateral spasm of the longitudinal muscles of the back and thighs. The peripheral joints were normal.

The blood pressure was 160/40 in the arms and 280/45-0 in the legs.

The hematocrit was 35 per cent, and hematologic studies were consistent with the anemia of active rheumatoid arthritis. The sedimentation rate was 40 mm. per hour; serologic tests were negative. An electrocardiogram showed 1st-degree atrioventricular block, with a PR interval of 0.32 second and hypertrophy of the left ventricle. Radiologic examination revealed considerable enlargement of the left ventricle, with a prominent rocking ventricular and aortic pulsation. The vertebral longitudinal ligaments were calcified throughout the entire spine, especially in the lumbar region, where there was bambooing. There was osteoporosis of the vertebral bodies and indistinct articular margins. The lumbar interspinous ligaments were calcified. The left sacroiliac joint was obliterated, and there was marked narrowing and irregularity of the right sacroiliac joint.

The patient was discharged to return in 6 months for cardiac surgery, when the Hufnagel plastic valve was placed in the 1st part of the descending aorta.

The active spondylitis was causing as much distress

to this patient as his severe heart disease. *He was anemic, and like that of the rest of these patients his arthritis was severe and active and had recently required therapy. He was the only patient who had peripheral rheumatoid arthritis with the onset of his spinal disease,* and he had iritis on two occasions.

CASE 4. A 61-year-old dentist had had intermittent pain and stiffness since the age of 35, with progressive rigidity of the lumbrosacral spine. At the age of 51 he was hospitalized after an episode of syncope, and a heart murmur was discovered. A few years thereafter, he noted prominent arterial pulsations and pounding in the head. Five years before admission, the arthritis began to involve the cervical spine, and cortisone therapy was begun. Congestive heart failure promptly developed, and he was hospitalized in acute pulmonary edema with fever. The diagnosis of severe aortic insufficiency was made. After the cessation of cortisone therapy he became asymptomatic. At the age of 58, 3 years before admission, dyspnea on exertion, orthopnea, paroxysmal nocturnal dyspnea and palpitation gradually developed, and he was digitalized after another episode of acute pulmonary edema. In the year before admission he began a 3-day work schedule because of progressive dyspnea on exertion, and had another episode of pulmonary edema requiring further hospitalization. There was no history of rheumatic fever, syphilis, iritis, pericarditis, hemoptysis or angina.

Physical examination showed a slightly obese man in no acute distress. There were Grade 1 arteriosclerotic changes in the retinal vessels. Fine, crepitant inspiratory rales were present at the base of the right lung posteriorly. The heart was enlarged, the border of dullness extending to the anterior axillary line, with the point of maximum impulse in the 6th intercostal space. The pulmonic 2d sound was louder than the aortic. The 1st mitral sound was not accentuated. There was a Grade 3 aortic harsh systolic murmur and a Grade 3 blowing decrescendo diastolic murmur heard best along the left sternal border. At the apex there was a Grade 2 high-pitched systolic murmur, a Grade 2 diastolic rumbling murmur and a ventricular diastolic gallop. The liver edge was felt 1 fingerbreadth below the right costal margin. There was no dependent edema. The peripheral vascular signs of severe aortic insufficiency were present. There was accentuated dorsal kyphosis and increased chest diameter, with poor expansion. Lumbar lordosis was ironed out, and there was a poker spine and limitation of motion extending from the sacroiliac joint, where it was most marked, to the cervical region. The peripheral joints were normal.

The blood pressure was 180/50 in the arms and 220/50 in the legs.

The hematocrit was 45 per cent, and the sedimentation rate 40 mm. per hour; serologic tests were negative. An electrocardiogram showed prominent P waves and hypertrophy of the left ventricle. Radiologic examination revealed marked hypertrophy of the left ventricle and a prominent rocking ventricular and aortic pulsation. There were dorsal kyphosis, calcification of the vertebral longitudinal ligaments with bambooing and osteoporosis of the vertebral bodies and ischium. The patient was discharged on the 4th hospital day to continue medical management under the care of his physician.

Spondylitis had been present for twenty-six years and heart disease for only ten years. The incapacitation was predominantly the result of chronic heart failure.

CASE 5. A 41-year-old man stated that at the age of 3 he had been put to bed with his left leg in a cast; the details of this illness were not available. When he was 29 years old back pain first developed and over the years it became progressively disabling, with pain and limitation of motion of the lumbosacral spine and intermittently painful hips and thighs. Various methods of therapy were without benefit. A heart murmur was discovered at the age of 38. Three years before admission progressive dyspnea on exertion, orthopnea and ankle edema developed, and he was treated for congestive heart failure. He had recently been hospitalized twice for episodes of paroxysmal atrial tachycardia and ventricular tachycardia. In spite of intensive medical therapy, his activity became so limited that he was confined to bed and chair. There was no history of rheumatic fever, syphilis, iritis, pericarditis, angina, hemoptysis or peripheral arthritis except for the hips.

Physical examination showed an anxious man who appeared chronically ill. The lungs were clear. The heart was enlarged, the border of dullness extending to the midaxillary line, with the point of maximum impulse in the 6th intercostal space. The pulmonic 2d sound was louder than the aortic. The 1st mitral sound was not accentuated. There was a Grade 3 aortic harsh systolic murmur and a Grade 3 blowing decrescendo diastolic murmur heard best along the left sternal border. At the apex there was a Grade 3 high-pitched systolic murmur, a Grade 3 rumbling diastolic murmur and a ventricular diastolic gallop. The liver edge was felt 2 fingerbreadths below the right costal margin. There was no dependent edema. The peripheral vascular signs of severe aortic insufficiency were present. There was an increase in dorsal kyphosis and chest diameter, with poor expansion and loss of lumbar lordosis. There was a poker spine, with generally poor range of motion. No evidence of peripheral arthritis was noted.

The blood pressure was 140/20-0 in the arms and 260/30-0 in the legs.

The hematocrit was 43 per cent, and the sedimentation rate 33 mm. per hour; serologic tests were negative. An electrocardiogram showed 1st-degree atrioventricular block, with a PR interval of 0.36 second. There was hypertrophy of the left ventricle, with deep, broad Q waves in Leads 2, 3, aVF and V_6 typical of an old diaphragmatic myocardial infarction (Fig. 4). Radiologic examination revealed considerable enlargement of the left ventricle, with prominent rocking ventricular and aortic pulsations; the esophagus

TABLE 1 *(Concluded).*

CASE NO.	ELEVATED SEDIMENTATION RATE	ANEMIA	SEVERE AORTIC INSUFFICIENCY	BLOOD PRESSURE	X-RAY EVIDENCE OF LEFT-VENTRICLE HYPERTROPHY	ELECTROCARDIOGRAPHIC EVIDENCE OF LEFT-VENTRICLE HYPERTROPHY	1ST-DEGREE HEART BLOCK	DEATH FROM HEART DISEASE
1	Present	Absent	Present	160/40	Present	Present	Present	Yes
2	Present	Present	Present	130/44	Present	Present	Present	Yes
3	Present	Present	Present	160/40	Present	Present	Present	No
4	Present	Absent	Present	180/50	Present	Present	Absent	No
5	Present	Absent	Present	140/20	Present	Present	Present	Yes
Average				150/40				

was displaced posteriorly in the region of the left atrium (Fig. 5). The vertebral longitudinal ligaments were calcified. There was bambooing of the entire spine. There was osteoporosis of the vertebral bodies and ischium. The intervertebral articulations were indistinct in the lumbosacral region, and there was bony fusion of the sacroiliac joints (Fig. 6). The patient was discharged, his chronic cardiac decompensation somewhat improved on intensive medical therapy. Three months later he re-entered the hospital in severe congestive heart failure. After initial improvement, he died suddenly on the 6th hospital day. Permission to perform an autopsy was not obtained.

Progressive, severe heart failure caused this patient's death. His far-advanced heart disease, together with the presence of the rheumatoid spondylitis and its interference with pulmonary ventilation, was considered to make the risk of surgery prohibitive. The electrocardiographic evidence of an old myocardial infarction has been seen in other patients with marked aortic insufficiency who on autopsy were found to have patchy areas of myocardial fibrosis without coronary occlusion.[19,20]

Discussion

These 5 patients were remarkably similar in many respects (Table 1). They all had severe rheumatoid spondylitis with sacroiliac disease and spinal involvement extending to the cervical region, with a poker-spine deformity. Each had required recent therapy for his arthritis although the average duration of the disease was twenty-three years. They all had slight to markedly elevated sedimentation rates, and 2 had an anemia. None gave a history of pericarditis, and only 1 a history of iritis. One had unequivocal peripheral rheumatoid arthritis with the onset of his spinal disease, and none had evidence of it on physical examination. All had far-advanced heart disease, with severe aortic insufficiency, and 3 died of it. The average age when the patients were first seen was forty-nine years, and the duration of known heart disease ranged from two to ten years, with an average of seven years. None had a history of syphilis, and only 1 had a definite history of acute rheumatic fever. The physical findings, x-ray films and electrocardiograms of all were strikingly alike. There was physical evidence of severe aortic insufficiency and cardiac enlargement that was confirmed by radiologic studies. All had the electrocardiographic patterns of hypertrophy of the left ventricle, first-degree atrioventricular block occurring in 4 of the 5. The serologic tests were negative in all. The pathological findings in 2 cases were believed to represent chronic rheumatic heart disease, although there were some features worthy of note. The mitral valves were grossly normal, and 1 had only minor microscopical changes. Except for thickening and some shortening, the aortic valves were otherwise grossly normal, without commissural irregularity or obliteration. No Aschoff bodies were seen in several sections, and there was extensive pathologic destruction of all three layers of the root of the aorta in Case 2. These cases of heart disease are similar to those reported with rheumatoid spondylitis in that there was a valvular lesion and that it was principally confined to the aortic valve. In other features they differ. First of all, there was usually not a history of rheumatic fever. Secondly, peripheral rheumatoid arthritis was not common, occurring with certainty in only 1 patient, who had no physical evidence of it on admission. Finally, the heart disease was not benign, 3 patients having already died and the prognosis of the other 2 being quite unfavorable.

These cases comprise 5 per cent of a select group of 100 patients with aortic-valve disease. They were sent for evaluation because of severe aortic insufficiency and were predominantly functional Class 3 or 4. Seventy-five per cent of these cases were in males. The majority had been screened for mitral-valve disease before being sent here. Thus, the severity of the disease and to some extent the lack of a mitral-valve lesion can be explained by case selection. The chance of coincidental aortic insufficiency and rheumatoid spondylitis was slightly higher since both are more common in males. However, a chance occurrence of rheumatoid spondylitis in 5 per cent of 100 patients with aortic insufficiency is extremely unlikely since the disease is not that common. The incidence of rheumatoid spondylitis in a general hospital population is probably less than 0.1 per cent.[6] With our cases of congenital, syphilitic and traumatic etiology excluded, as well as the females (because of the rarity of rheumatoid spondylitis in women), the incidence in our series is 5 cases of rheumatoid spondylitis in 60 male patients with severe aortic insufficiency, or 8.3 per cent. Therefore, it is even less likely that coincidence could offer an explanation. It is noteworthy that we have not observed a case of rheumatic spondylitis associated with mitral stenosis in several hundred patients seen here during the last several years, although the majority of them were females.

No attempt is made to explain the etiology of the heart disease in these patients. It may have been due to coincidental rheumatic fever, although only 1 of these patients had a clear-cut history of rheumatic fever. A strong possibility exists that rheumatoid spondylitis, a collagenous disease in the broad sense and closely allied to rheumatic fever and rheumatoid arthritis, occasionally causes heart disease with a predilection for the aortic valve, where it produces endocarditis and valvulitis. This would support the concept of a close relation between these diseases.

Summary and Conclusions

Five cases of rheumatoid spondylitis with aortic insufficiency are presented.

They represented an unusual occurrence of rheumatoid spondylitis in 5 per cent of 100 cases of aortic insufficiency recently evaluated for surgery.

They were remarkably similar: none had a history of syphilis (only one had definite rheumatic fever, and 1 peripheral rheumatoid arthritis); the heart disease and aortic insufficiency were severe, and 3 patients died of it (all had free aortic insufficiency and left-ventricle hypertrophy, and 4 had first-degree atrioventricular block); the rheumatoid spondylitis was advanced, and all patients were symptomatic with elevated sedimentation rates and 2 were anemic; there was an interval of many years between the onset of spinal disease and clinical heart disease.

Post-mortem study in 2 cases showed aortic valves that were insufficient, thickened and shortened, with fibrosis at the base but without commissural irregularity or obliteration. There was involvement of all layers of the aortic root, with intimal calcification in 1 case. The mitral valves were normal, and no Aschoff bodies were discovered.

A direct relation must exist between the rheumatoid spondylitis and the valvulitis in these cases.

Since this paper was submitted for publication we have seen another patient with severe rheumatoid spondylitis and aortic insufficiency, a 52-year-old man who had symptoms of rheumatoid spondylitis for 5 years with x-ray evidence of involvement of the spine and sacroiliac joints that was judged to be many years older. He had 1 episode of transient arthritis of the right wrist and fingers 10 years previously, with slight residual deformity. Heart disease was discovered 3 years before admission, and symptoms of congestive heart failure and angina had been present for 2 years. He denied rheumatic fever, syphilis, iritis, pericarditis or hemoptysis. The blood pressure was 190/20, and there was physical and x-ray evidence of severe aortic insufficiency. An electrocardiogram showed 1st-degree atrioventricular block, with a PR interval of 0.28 second and hypertrophy of the left ventricle. The corrected sedimentation rate was 37 mm. in 1 hour, with a normal hematocrit. He was denied surgery because of the severity of the heart disease and his age. Although none of the other patients in this report have had angina it has been observed in 50 per cent of our patients with severe rheumatic aortic insufficiency.[19,20]

An additional observation of valvular heart disease in 6 of 128 patients with rheumatoid spondylitis has recently been reported.[21] There was usually a history of rheumatic fever, aortic insufficiency was common, the heart disease was not benign, and some of the patients died of it.

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EFFECT OF CIGARETTE SMOKING ON GASTRIC SECRETIONS OF PATIENTS WITH DUODENAL ULCER*

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MANY clinical opinions on the effect of smoking on gastric secretions have been expressed, but a careful review of the literature fails to reveal any studies sufficiently detailed or adequately controlled to substantiate such opinions scientifically.

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Haag[1] believed that the effects of smoking on the gastrointestinal tract were variable, depending on which of the autonomic ganglionic systems was more stimulated.

Gray[2] reported that 50 of 63 patients with duodenal ulcer showed an increase in the volume of gastric secretion after smoking, and a fourth of the patients showed a concomitant rise of gastric acidity. Schnedorf and Ivy[3] found that gastric acidity increased after smoking in 1 of 20 patients with duodenal ulcer. Rosenblum[4] observed that smoking caused a rise in gastric acidity in 15 and in the

volume of gastric secretions in 12 of 19 patients with duodenal ulcer. Similarly, Ehrenfeld and Sturtevant[5] stated that 20 of 23 patients with peptic ulcer had an increase of gastric acidity after smoking. Steigmann et al.[6] studied 54 patients with ulcer and found increased gastric acidity in 90 per cent after smoking of regular and in 60 per cent after smoking of filter-tip cigarettes. Hodges and Gilmour[7] reported that only 2 of 16 patients with duodenal ulcer had an increase of gastric acidity after smoking.

TABLE 1. *Comparative Data on "Smokers" and "Controls."*

GROUP	NO. OF PATIENTS	AGE		AVERAGE DURATION OF ULCER SYMPTOMS	PATIENTS WITH COMPLICATIONS OF ULCER				RESPONSE TO MEDICAL TREATMENT		
		AVERAGE	RANGE		GROSS BLEEDING	PERFORATION	COMBINED HEMORRHAGE & PERFORATION	OBSTRUCTION	GOOD	FAIR	POOR
		yr.	*yr.*	*yr.*							
"Smokers"	60	43	21-61	11	25	8	1	1	23	32	5
"Controls"	60	44	26-69	10	28	5	1	2	22	29	9

The present study was composed of two parts. The first concerned 120 patients with duodenal ulcer, who were divided into two groups, one smoking and the other not smoking during the test periods. These are referred to as "smokers" and "controls," respectively. Changes in the volume, pH, "free acid," pep-

TABLE 2. *Volume, pH, "Free Acid," Peptic Concentration and Output of Gastric Secretions of 60 "Smokers" and 60 "Controls" during the Basal Period.**

GROUP	NO. OF PATIENTS	GASTRIC SECRETION			PEPTIC CONCENTRATION	PEPTIC OUTPUT
		VOLUME	pH	FREE ACID		
		ml.		*units*	*units/ml.*	*units/½ hr.*
"Smokers"	60	63.3±4.2	2.19±0.19	33.0±3.2	9.6±0.7	622.0±62.0
"Controls"	60	57.9±4.1	2.08±0.16	35.1±2.9	10.8±0.9	630.0±73.0

*Mean values, with standard errors.

TABLE 3. *Patients with Increase, Decrease or No Change in the Various Aspects of Gastric Secretion.**

ASPECT OF SECRETION	PERIOD	"SMOKERS"	"CONTROLS"	"SMOKERS" WITH INCREASE		"CONTROLS" WITH INCREASE		"SMOKERS" WITH DECREASE		"CONTROLS" WITH DECREASE		"SMOKERS" WITH NO CHANGE		"CONTROLS" WITH NO CHANGE	
		NUMBER	NUMBER	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
Volume	1	60	60	21	35	21	35	33	55	36	60	6	10	3	5
	2	60	60	10	17	16	27	45	75	37	62	5	8	7	12
	3	47	58	13	28	23	40	33	70	34	59	1	2	1	2
pH	1	60	60	23	38	20	33	25	42	28	47	12	20	12	20
	2	60	60	23	38	27	45	27	45	26	43	10	17	7	12
	3	47	58	21	45	27	47	18	38	24	41	8	17	7	12
Free acid	1	60	60	27	45	32	53	30	50	23	38	3	5	5	8
	2	60	60	27	45	29	48	29	48	28	47	4	7	3	5
	3	47	58	19	40	25	43	24	51	29	50	4	9	4	7
Peptic concentration	1	60	60	34	57	39	65	23	38	21	35	3	5	0	0
	2	47	58	22	47	34	59	22	47	23	40	3	6	1	1
	3	47	58	25	53	34	59	22	47	22	38	0	0	2	3
Peptic output	1	60	60	31	52	23	38	29	48	37	62	0	0	0	0
	2	47	58	16	34	24	41	31	66	34	59	0	0	0	0
	3	47	58	18	38	29	50	28	60	29	50	1	2	0	0

*3 periods of each subject compared with basal period.

tic concentration and output of the gastric secretions were determined. The second part of the present study was limited to determinations of the pH changes of gastric juice after smoking, and broth stimulation and insulin stimulation in 16 patients before and in 11 patients after partial gastrectomy for duodenal ulcer.

The effect of smoking on the gastric secretions of patients without duodenal ulcer is being studied by Kirsner.[8]

Clinical Material

The study group was composed of 147 male patients who had had a clinical diagnosis of duodenal ulcer established within the past six years at the Providence Veterans Administration Hospital. Patients were excluded from the study if they were over sixty-nine years of age or had evidence of advanced coronary sclerosis, severe hypertension or some other serious medical condition. In the group not operated on any patient with a history of massive gastrointestinal hemorrhage within a year was excluded.

The "control" group was composed of 16 patients who were nonsmokers and alternate patients from the remaining 104 of the 120 patients who were investigated in the first part of the study. The clinical data for the "smokers" and "controls" are shown in Table 1. Similarity between the two groups is evident.

The average number of cigarettes smoked per day during the previous six months was 21 by the "smokers" and 18 by the "controls."

Nine of the postoperative patients had a two-thirds to three-quarters gastric resection, and 2 had a hemigastrectomy and vagotomy. The average time elapsed after surgery was one year (range, one month to three years).

Methods

Patients were admitted to the hospital on the evening before the test. All refrained from smoking, eating or drinking after 10 o'clock. Sedation was not given. The study included a complete history and physical examination, x-ray film of the chest, blood count and urinalysis.

On the next morning, at 8 o'clock, a Levin tube, No. 14 — 16 Fr., was inserted into the stomach. If there was any uncertainty about the position of the tube, it was checked fluoroscopically. Throughout the test, the Gomco suction was interrupted at intervals to avoid plugging of the openings of the Levin tube. The stomach contents were aspirated for twenty minutes and discarded.

In the group of 120 patients gastric secretions were collected in four successive thirty-minute periods, as follows: basal period and periods 1, 2 and 3. During period 1 the "smokers" used their own brands of cigarettes and smoked continuously at their own accustomed speed. The cigarettes were smoked for

Table 4. *Mean Changes from Basal Values in the Various Aspects of Gastric Secretion.**

Aspect of Secretion	Period	No. of Patients		Mean Change for "Smokers"†	Mean Change for "Controls"†
		"smokers"	"controls"		
Volume (ml.)	1	60	60	−6.3±4.8	−16.2±4.7‡
	2	60	60	−17.9±3.5‡	−17.3±4.1‡
	3	47	58	−14.1±5.4‡	−5.6±4.7
pH	1	60	60	+0.007±0.15	−0.08±0.14
	2	60	60	+0.003±0.13	−0.07±0.12
	3	47	58	+0.319±0.18	+0.07±0.16
Free acid (units)	1	60	60	+0.02±1.79	+0.67±2.39
	2	60	60	+1.43±2.5	−0.57±2.94
	3	47	58	+1.04±3.31	−0.79±2.93
Peptic concentration (units/ml.)	1	60	60	+0.96±0.54	+0.63±0.73
	2	47	58	+1.84±0.70‡	+1.28±0.72
	3	47	58	+2.06±1.01‡	+1.84±0.95
Peptic output (units/½ hr.)	1	60	60	−26.0±57.5	−114.8±76.0
	3	47	58	−100.2±52.6	−115.3±55.0‡
	3	47	58	−32.0±72.3	−27.0±64.9

*3 periods of each subject compared with basal period.
†Mean changes, with standard error.
‡Represents statistically significant change: P = 0.05 or less.

three quarters of their length, and an average of two and a half cigarettes were smoked. The "control" group of patients completed identical tests except that they refrained from smoking during period 1. During periods 2 and 3, none of the patients smoked. Some patients were not studied for all determinations during periods 2 and 3. The number studied, however, was considered adequate for comparative purposes and for statistical analysis.

In the patients with duodenal ulcer before and after operation a period of broth and a period of insulin stimulation followed a thirty-minute basal period and a thirty-minute smoking period; 60 ml. of peptone beef broth was injected through a Levin tube twenty minutes after the smoking period, and in an additional twenty minutes, broth and gastric secretions were aspirated and discarded. The gastric secretions were then collected over a sixty-minute period. After that, regular insulin, 0.08 unit per pound of body weight, was injected intravenously and two one-hour aliquots of gastric secretions collected. pH determinations were accomplished on all specimens of gastric secretion with the Beckman meter.

The volume of all gastric specimens was measured. "Free acid" was determined by electrometric titration to a pH of 3.5. (The term "free acid" is put in quotation marks because buffers present in gastric secretions may influence the titration.) Gastric pepsin was determined by the method of Tomarelli et al.,[9] as modified by Mager and Farmer.[10]

The room temperature was maintained at 72°F. All patients were instructed to expectorate excessive saliva.

In this study all numerical data were subjected to statistical analysis by the determination of means and the standard errors of the means. Figures were analyzed by the "t" test of Fisher, and a P value of 0.05 or less was considered significant.

Results

The volume, pH, "free acid," peptic concentration and peptic output for the thirty-minute basal period were determined for both the "smokers" and the "controls" (Table 2). There were no significant differences between the two groups.

For each subject the volume, pH, "free acid," peptic concentration and output in periods 1, 2 and 3 were compared with his basal determinations. The numbers and percentages of "smokers" and "controls" showing an increase, decrease, or no change in the various aspects of gastric secretion in periods 1, 2 and 3 are presented in Table 3.

The mean changes from basal values in the volume, pH, "free acid," peptic concentration and output in periods 1, 2 and 3 for the "smokers" and for the "controls" are presented in Table 4. The decrease in volume and the increase in peptic concentration in periods 2 and 3 were significant in the "smokers." In the "controls" the decrease in volume in periods

TABLE 5. *Statistical Analysis of Results.*

Aspect of Secretion	Period	No. of Patients		Mean Change		Mean Difference*	"t" Value†	Probability	Significant Change‡
		"smokers"	"controls"	"smokers"	"controls"				
Volume (ml.)	1	60	60	−6.3	−16.2	9.9	1.48	0.13	None
	2	60	60	−17.9	−17.3	0.6	0.11	0.55	None
	3	47	58	−14.1	−5.6	8.5	1.19	0.23	None
pH	1	60	60	+0.007	−0.08	0.087	0.44	>0.55	None
	2	60	60	+0.003	−0.07	0.073	0.412	>0.549	None
	3	47	58	+0.319	+0.07	0.249	1.02	0.32	None
Free acid (units)	1	60	60	+0.02	+0.67	0.65	0.22	>0.55	None
	2	60	60	+1.43	−0.57	2.00	0.51	>0.55	None
	3	47	58	+1.04	−0.79	1.83	0.41	>0.55	None
Peptic concentration (units/ml.)	1	60	60	+0.96	+0.63	0.33	0.36	0.37	None
	2	47	58	+1.84	+1.28	0.56	0.56	0.55	None
	3	47	58	+2.06	+1.84	0.22	0.11	>0.55	None
Peptic output (units/½ hr.)	1	60	60	−26.0	−114.8	88.8	0.93	0.37	None
	2	47	58	−100.2	−115.3	15.1	0.20	>0.55	None
	3	47	58	−32.0	−27.0	5.0	0.05	>0.55	None

*"Smokers" minus "controls."
†Fisher "t" test.
‡P=0.05 or less.

1 and 2 and the increase in peptic output in period 2 were significant (Table 4).

The analyses of results so far have been limited to changes in values within the "smoker" group or within the "control" group. The comparison between the "smokers" and the "controls" is presented in Table 5. It is evident that the changes in the volume, pH, "free acid," peptic concentration and peptic output in periods 1, 2 and 3 did not differ significantly in the two groups.

The results of the study in the patients with duodenal ulcer before and after operation are shown in Table 6. It is evident that there was an elevation of the pH of gastric secretion during the thirty-minute smoking period in both groups. In the preoperative group both broth and insulin stimulation resulted in a reduction of pH. In the postoperative group a slight reduction in pH followed broth stimulation, and a further reduction followed insulin stimulation.

TABLE 6. *Mean pH Values and Their Standard Errors before and after Operation.*

PERIOD	PREOPERATIVE pH AND STANDARD ERROR*	POSTOPERATIVE pH AND STANDARD ERROR†
Basal period	2.0±0.2	5.9±0.5
Smoking period	2.3±0.4	6.5±0.5
Broth-stimulation period	1.9±0.4	6.2±0.6
Insulin-stimulation period‡	1.6±0.3	5.2±0.9

*16 patients.
†11 patients.
‡Lower pH of 2 60-min. periods.

DISCUSSION

The present investigation was divided into two parts. The first and more extensive part was an investigation of 120 patients with duodenal ulcer who were divided into two 60-patient groups. Sixty patients smoked for a thirty-minute period, and 60 patients refrained from smoking during the study and acted as "controls." Within the "smoker" or "control" group there were significant alterations in volume, peptic concentration or peptic output in one or more periods. However, comparison between the "smokers" and the "controls" revealed no significant differences between the volume, pH, "free acid," peptic concentration or peptic output; this finding is believed to be the most important part of the present investigation.

The second phase of the investigation involved 27 patients; 11 had had a partial gastrectomy for duodenal ulcer, and 16 were being prepared for that operation. The pH of the gastric juices was determined for basal, smoking, broth-stimulation and insulin-stimulation periods. It was found in both groups that the pH was elevated during the smoking period.

SUMMARY

Under the conditions of the investigation, the smoking of cigarettes by patients with duodenal ulcer did not produce significant changes in the volume, pH, "free acid," peptic concentration or peptic output of gastric secretions.

We are indebted to Herman B. Chase, biometrician and professor of biology, Brown University, Providence, for reviewing the statistical methods and data, and to Mrs. Goldwyn A. Moore and Mrs. Frances E. Roberts, technicians, and Mrs. Dorothy H. Burke, biochemist, Surgical Research Laboratory, Veterans Administration Hospital, Providence.

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INTERMITTENT INTRAVENOUS THERAPY*

Experience with a Simple Method for the Administration of Heparin and Other Drugs in 269 Medical and Surgical Patients

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BOSTON

A PRELIMINARY report in 1954[1] described the successful use of a new method for the administration of heparin through an indwelling venous catheter that eliminated the need for repeated venipunctures. The efficacy and safety of this method have now been studied in 269 medical and surgical patients who received heparin or a wide variety of other medications by this technic. The present communication summarizes this entire experience.

METHOD§

Polyethylene tubing, in 15-cm. lengths and 0.965 mm. in external diameter,¶ was filled with a solution of 1:1000 benzalkonium chloride (Zephiran Chloride) and immersed in sterile test tubes filled with the same antiseptic. The test tubes were covered with sterile corks, which were secured in position with adhesive tape. The tubing remained in the solution for a minimum of eighteen hours before use.

Before the catheter was inserted, the skin of the patient's forearm was thoroughly cleansed with soap and water and washed with 70 per cent isopropyl alcohol. A tourniquet was applied above the elbow, and the forearm surrounded with sterile towels. The catheter was removed aseptically from the benzalkonium solution, the outer wall washed with sterile 0.85 per cent saline solution, and the lumen flushed with the same solution by a syringe attached to a 26-gauge needle. A thin-walled, 18-gauge needle attached to a 5-ml. syringe was inserted into a superficial forearm vein. After the withdrawal of 5 ml. of blood for the initial clotting-time determination, the tourniquet was released, the syringe detached from the needle, and 10 cm. of the catheter threaded through the needle into the vein. The catheter was held in place by counterpressure proximal to the needle, which was withdrawn from the vein, and the free end of the tubing secured to a sterile No. 610A Tuohy–Borst adapter.‖ The open end of the adapter was covered with a sterile No. 11A rubber-sleeved stopper** from which the sleeve was cut away before sterilization. Figure 1 shows the four pieces of equipment. The catheter and adapter were secured separately with adhesive tape and covered with an ace bandage, only the rubber cap being left exposed (Fig. 2). After the outer surface of the stopper had been cleansed with 70 per cent isopropyl alcohol, 0.4 ml. of dilute heparin (10 mg. per milliliter) was injected through it by means of a tuberculin syringe and a 26-gauge needle. When the catheter had been inserted, the patient was permitted unrestricted use of the extremity. Prophylactic chemotherapy was not employed.

The heparin dosage schedule varied from eight-hour injections to a constant intravenous drip. When heparin was given intermittently, the outer surface of the rubber cap was cleansed with isopropyl alcohol before each injection. For a constant drip, the needle from the bottle for intravenous injection was inserted through the cleansed, rubber-capped Tuohy–Borst adapter and secured in place. The majority of patients received heparin on a four-hour schedule in which the dosage was determined by the response of the clotting time. Blood samples for clotting-time and other determinations were not obtained from the catheter. At the conclusion of therapy, the catheter was simply removed from the vein; only the metallic portion of the Tuohy–Borst adapter was salvaged for subsequent use. Prolonged infusions of substances other than heparin were administered through a 21-gauge needle inserted through the rubber stopper. This delivered approximately 3000 ml. of fluids in twenty-four hours. When infusions of material such as whole blood or packed red cells were used, larger catheters, 1.27 mm. in external diameter, were inserted percutaneously through thin-walled 16-gauge needles. When heparin was not used therapeutically, it was injected in 4-mg. amounts every eight to twelve hours to maintain patency of the catheter and adapter.

RESULTS

Heparin Group

Heparin was administered by catheter to 214 pa-

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§Although details of the technic have been described previously,[1] they are repeated here.

¶Manufactured by Clay-Adams Company, New York City.

‖Manufactured by Becton-Dickinson Company, Rutherford, New Jersey.

**Manufactured by the West Company, Phoenixville, Pennsylvania.

tients.* The drug was given therapeutically to 83 patients with thrombophlebitis, 57 with pulmonary embolism and 26 with peripheral arterial emboli. Heparin was also administered prophylactically to 43 patients with acute myocardial infarction, 2 with chronic peripheral arterial occlusive disease, to 2 patients for the period required to convert their atrial fibrillation to a normal sinus rhythm and to an elderly man who was immobilized because of a hip fracture. The ages of the patients ranged from fifteen to ninety years; three quarters of them were more than fifty years of age.

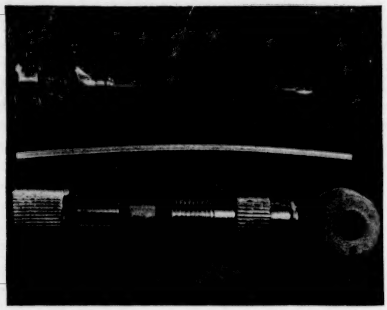


FIGURE 1. *Photograph, Showing the No. 18 Thin-Walled Needle, 0.965-Mm. Polyethylene Tubing, Tuohy–Borst Adapter (Separated into Its Constituent Parts) and the Rubber Cap Used for Injection of Heparin.*

In 95 per cent of the patients receiving heparin through the catheter, the contemplated course of therapy was completed with the technic described.

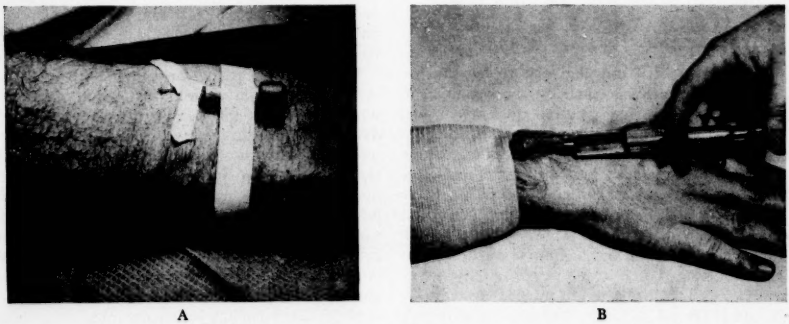
*Thirteen of these patients received more than one course of heparin therapy: each course was counted separately for the purposes of this study.

Of the 11 patients (5 per cent) in whom treatment was interrupted because of complications, therapy was discontinued in 6 because of localized phlebitis about the catheter, in 4 because of mechanical plugging of the vein or catheter and in 1 because no additional superficial veins could be located. A quarter of the patients required, during their course of treatment, a change of catheter for technical difficulties or because of local discomfort. The catheter was in place for a week or more in two thirds, for two or more weeks in a quarter and for three weeks or longer in a tenth of the patients. The longest period of use of a single catheter free of any difficulty was six weeks.

Infusion Group

The catheter was utilized for the administration of a variety of substances alone or occasionally in conjunction with heparin therapy in 55 patients. A list of the various infusions successfully used is shown in Table 1.

The duration of therapy in patients receiving drugs other than heparin through the catheter was shorter than that in the heparin group. Only half the former received medication for more than four days. Thirty per cent, however, received drugs through the catheter for a week or more, and in 2, fluids were infused intermittently for more than three weeks. Again, in 25 per cent of the patients, it was necessary to change the tubing because of local irritation or obstruction. In 15 per cent, however, therapy was discontinued because of these difficulties. Some of these reactions may have resulted, in part, from the irritating substances injected.



A B

FIGURE 2. *Photograph, Showing the Catheter in Place* (A), *Secured with Adhesive Tape, and* (B) *Covered with an Ace Bandage (the Bandage is Not Removed for Injections).*

Complications from the Catheter

Correctly inserted catheters generally functioned effectively and were well tolerated. Since they were

placed in superficial forearm veins, they could be readily inspected. Polyethylene tubes were inserted in some cases into previously traumatized vessels without inducing any local reaction. In no patient was ascending superficial or deep thrombophlebitis, embolism or infection from the catheter encountered. In 3 patients, in association with a moderate local reaction, there was low-grade fever for one to three days. As previously described,[1] cultures of the catheter tips and of the Tuohy–Borst adapters were found to be sterile on repeated examination. The hazard of low-grade reaction, although minimal, is always present and requires that care be taken in the insertion of the catheter and that the rubber cap be cleansed before each injection. At the beginning of this study, catheters were removed from a vein, and a fresh one inserted into the contralateral extremity, at the first complaint of discomfort on the part of the patient. It became clear, however, that these complaints were insignificant in most cases. Catheters were therefore left in place until the patient had an increase in discomfort over a twelve-hour period. The application of an icebag or, in an occasional case, a hot water bottle to the painful area was frequently associated with a pronounced decrease in pain within several minutes. Catheters are currently removed only after pain of a degree disturbing to the patient persists for twenty-four hours despite cold or hot packs. Patients with this type of minor discomfort are doubtless experiencing an aseptic inflammatory reaction secondary to catheter irritation of the vein wall. This usually subsides spontaneously. There was 1 case in which the catheter became detached from the adapter and escaped just within the skin-puncture site. The tubing was readily removed through a small incision in the arm, where the catheter, which had been inserted three days earlier, was found well anchored in the superficial vein. It was not possible to determine retrospectively whether the catheter and adapter had been separately taped to the skin.

Occasional failure of the apparatus to deliver the medications to a vein may result from too tight an application of the Tuohy–Borst adapter to the catheter wall. This may be easily corrected by adjustment of the adapter. The catheter and adapter should be securely and separately taped to the skin of the forearm, and the entire apparatus covered by an ace bandage. Nurses should be instructed not to apply the ace bandage so tightly that it will produce edema of the hand.

TABLE 1. *Drugs Given by Catheter.*

FLUIDS & ELECTROLYTES	**VITAMINS**
Glucose in water, 5%	B
Glucose in water, 10%	C
Physiologic saline solution	K
Sodium lactate, 1/6 molar	
Calcium gluconate, 10%	
Potassium chloride, 0.3-0.6% in 5% glucose in water	**HORMONES**
Sodium iodide, 0.5% in 5% glucose in water	ACTH
Potassium iodide, 0.5% in 5% glucose in water	Hydrocortisone
Ammonium chloride, 1% in physiologic saline solution	Insulin
	BLOOD & BLOOD PRODUCTS
ANTIBIOTICS	Whole blood
	Packed red blood cells
Sulfadiazine	Plasma
Penicillin	Albumin
Oxytetracycline	
Tetracycline	**MISCELLANEOUS**
Chloramphenicol	
	Theophylline
	Ephedrine
	Nor-epinephrine
	Meperidine (Demerol)
	Glutamic acid
	Protein hydrolysates
	Nitrogen mustards

DISCUSSION

The success of this technic has depended on the availability of a flexible, nonreactive, small-bore catheter, the avoidance of a surgical incision, the maintenance of asepsis in the insertion of the catheter and the ability to introduce heparin and other drugs into the venous circulation repeatedly through the rubber cap without causing infection. In the past, physicians have been required to administer all intravenous medications at the Beth Israel Hospital. Nurses are now permitted to give medications through the rubber-capped adapter just as they do subcutaneous and intramuscular injections. Injections into catheters are so free of discomfort that many patients sleep through the night injections. Both the enthusiasm of various physicians who have used the technic and the spontaneous expressions of appreciation by patients have reflected the clinical value of the method.

We have been particularly impressed by the use of this catheter in patients with acute myocardial infarction. It not only permits the ready intravenous administration of a variety of fluids, including such important drugs as nor-epinephrine, but also facilitates the use of heparin in these cases. Heparin can now be given to patients with acute myocardial infarction without a greater inconvenience to the patient than that incurred in the use of Dicumarol controlled by a daily determination of the prothrombin time. One of the major reasons why Dicumarol has enjoyed superiority over heparin in the treatment of hospitalized patients with acute myocardial infarction has been its ease of administration rather than any evidence that it is a more effective anticoagulant. The availability of the catheter has resulted in an increased use of heparin in the treatment of patients with acute myocardial infarction at the Beth Israel Hospital.

The results obtained in this study cannot be construed as evidence for or against the therapeutic efficacy of heparin. The dosage schedules varied appreciably, and the duration of administration of the drug as well as the indications for its use were

determined by the physician responsible for the individual patients who made up this series. All that can be claimed is that heparin may be given intravenously with safety and with greater convenience than was previously possible.

The administration of intravenous therapy besides heparin through the catheter allows for its wide use in many types of critically ill patients. The advantage of administering large doses of antibiotics by this technic to patients with subacute bacterial endocarditis or bacterial meningitis has been apparent. In seriously ill patients with electrolyte or hormonal imbalance, gastrointestinal bleeding or hypertensive encephalopathy, the catheter has facilitated the use of diverse intravenous therapy. Finally, early insertion of a catheter has proved most fortunate in patients with few superficial veins and in those in whom the loss of available superficial veins could be anticipated.

The chief hazards in the use of indwelling catheters are sepsis and the escape of the catheter into the circulation.[2] Although such catastrophes did not occur in this study, the hazards are always present and require that care be taken in the insertion of the catheter, in the securing of the catheter to the forearm and in the repeated cleansing of the rubber cap before injection. The fact that the catheter is placed in a superficial forearm vein provides a ready means whereby any local reactions may be discerned by the physician.

The insertion of a catheter takes but several minutes. The only skill required is that of performing a venipuncture satisfactorily. The equipment used for each patient costs $1.30, of which $1.20 represents salvageable parts. We believe that this type of apparatus will find expanding use in hospitals throughout the country because it is effective, safe and simple, saves time and is inexpensive.

Summary

A new method for the intravenous administration of heparin and other drugs without repeated venipunctures is described, and its use in 269 patients summarized. The technic is based on the insertion into a superficial forearm vein of an inlying polyethylene catheter attached to a rubber-capped Tuohy–Borst adapter. The success of the method has depended on the availability of a flexible, nonreactive, small-bore catheter, the avoidance of a surgical incision, the maintenance of asepsis in the process of insertion and the ability to introduce drugs into the system repeatedly through a rubber cap without causing infection or discomfort to the patient; 25 per cent of patients require, during their course of treatment, a change of catheter because of minor technical difficulties or because of mild local discomfort. No serious complications have occurred. Individual catheters have functioned satisfactorily for as long as six weeks. This apparatus should find expanding use in hospitals throughout the country because it is effective, safe and simple, saves time and is inexpensive.

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SPECIAL ARTICLE

RURAL HEALTH WORK IN INDIA*

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BELGAUM DISTRICT, S. INDIA

INDIA is a country of villages. In the whole of India there are 750,000 villages where nearly 80 per cent of the people live. These villages generally are far from the highway, and the roads leading to them are mainly of dirt and become almost impassable during the rainy season. Sanitary facilities are of the most primitive character and as a result intestinal parasites and enteric diseases are common. There is inadequate medical help in the villages — 1 doctor for every 6000 people and 1 nurse for every 43,000 people. Not all the villages have schools for their children, and a large percentage of the people are illiterate. But the younger generation is now waking up to the need for education, and important changes and developments are occurring.

Superstitions about Medicine

Many people in India still have the idea that sickness is due to anger of gods, so that when anyone falls ill, it is believed that the sick person is being visited by a particular god. Therefore, the relatives often

*In the new plans of the Indian government as outlined in the Community Development Program of the second Five Year Plan the number of rural health centers is to be rapidly increased. The objective is to provide all of India with basic health services. The accompanying description of the work of such a center was solicited from Dr. Selvanayagam, who recently spent a year studying at the Harvard School of Public Health.

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resort to appeasing that god first and send for the priest, who performs ceremonies and gives a peace offering in the form of coin, grain or coconut. For diseases like plague, cholera and smallpox some people get no treatment for fear of displeasing the respective deity. The result of the peace ceremony is usually awaited for three days. When nothing happens remedies suggested by the old folks at home are tried. After this the village practitioner is consulted. He tries measures that are often drastic and crude and may make the patient worse. By now the patient's father or anyone responsible may decide that he should be taken to a hospital or a qualified doctor, by which time the case may be hopeless. As an example, a man was taken ill with signs of intestinal obstruction. For the first three days, as usual, religious rites were practiced; home remedies followed, and the village practitioner was sent for. Finally, the family decided to take the patient to a hospital. Unfortunately, that day was the new-moon day, which was not auspicious. The patient was taken to the hospital in collapse eleven days after the symptoms appeared, too late for anything to be done.

In many cases the disease is masked, and the patient suffers from reactions to the crude treatment given him by the local practitioner. One day a patient was taken to the hospital with a severe dermatitis and stomatitis. The history revealed that he had been treated by some untrained man with crude arsenic and mercury. Thus, it is difficult to come to a conclusion about the diagnosis.

Some practitioners scarify the painful part of the body with a dirty knife to let out the "bad blood." In fection sets in and the patient is eventually seen with a severe cellulitis; when a detailed history is taken, the original disease, such as arthritis of some joint, is revealed.

A boy ten years old was taken to a completely untrained native practitioner for treatment of simple tonsillitis. The sore tonsils were massaged with salt and pepper. Only then was the poor victim admitted to the hospital with a high fever. In addition to these drastic measures most of the unscientific practitioners restrict the diets of their patients, sometimes almost starving them, adding greatly to their suffering and prolonging the illness.

Problems of Medical Practice

With conditions such as those mentioned above, it is evident that it is not an easy task to do health work in an Indian village. Health is affected by the many phases of village life, the home environment, socioeconomic conditions and religion. Therefore, anyone interested in village health work must look into the "whole man" and be an educator, a social worker, a physician and a friend. The vision of such a person should be large, and the work calls for the greatest compassion for the people among whom he practices.

Most of the maladies that the villagers suffer from are preventable. With proper health education and prophylactic and hygienic measures, most could be averted — malaria, anemia, malnutrition, enteric fevers, dysenteries, intestinal parasitism and tuberculosis. These are the common diseases, and they take a great toll of the people. The work therefore has to be a combined preventive and curative one. As opportunity arises, health education is given by word of mouth as well as by audiovisual aids.

Infant Nutrition

The state of nutrition is always an important consideration. Mothers do not have adequate knowledge of proper foods and in many areas children suffer from protein deficiency, marasmus or rickets. Sometimes, nursing is continued even up to the age of three to five years, for many of the mothers are too poor to afford any other food for their children. Under such circumstances the health worker has a task in teaching earlier weaning.

Prenatal Care

Prenatal work can play a great part in the health of mothers and children. It is a rare occasion, however, for village women to have attending obstetricians or to allow themselves to be examined by a doctor or nurse during pregnancy. When the health nurse advises them to attend the prenatal clinic, they may resent the advice at first. Later, with kindness and persuasion, they are influenced to come, timidly, but they soon learn the benefit of such care and continue their visits to the clinic until they have their babies. Preparation for confinement and getting clothes and other things ready for the baby are considered to be inauspicious. Therefore, the newborn child is generally received in old rags and wrapped in old clothes belonging to some other child. This fear also vanishes when the health nurse holds sewing classes and teaches mothers to make garments for their infants.

Delivery

The room chosen for the confinement is generally the dirtiest and darkest in the house; very often it is near a cattle shed. A confinement is considered a pollution — hence, it takes place away from the cleanest part of the house — the living quarters. Most mothers get help from untrained women at the time of delivery, for there are few trained midwives, not to mention obstetricians, in the villages. Attendants are usually from the barber or other low caste. They do not practice aseptic precautions and sometimes meddle too much and handle the woman roughly; consequently, both mothers and babies may suffer from sepsis and from injury. This is one of the main reasons for the high maternal and infant mortality in India. Moreover, these untrained women do not

know how to diagnose or cope with abnormalities. When labor is not over soon they often interfere, causing much damage, and when it is too late they give up. The relatives of the woman then sometimes take her to a hospital, by which time the baby may be dead, or the mother beyond help. Such occasions provide a receptive atmosphere in which the doctor or the health nurse may reach the people with a lecture on the value of prenatal examinations and the advantages of skilled and trained help during confinement.

Infant Care

Another service that can be of great benefit to the village community is the well-baby clinic. The doctor and the health nurse examine the babies, weigh them and instruct the mothers in the proper way of bringing them up. At the same time prophylactic inoculations can be given to prevent the various infantile and childhood epidemics. Weighing the babies is considered inauspicious by some because of the evil-eye theory; if someone exclaims that the baby's weight is increasing, the interpretation may be made that the baby will fall ill and die. Here, too, the health worker has to use persuasion, combined with understanding and sympathy for the ignorant and their fears.

Visits by Health Nurses

The most important part of any health work in the villages is home visiting by the health nurse. This enables her to come in contact with the people, to establish confidence among them and also to detect illness and defects in sanitation in the home and to give advice accordingly. In addition, house visiting aids in follow-up work, the nurse trying to visit the houses at a time when the women are free. This gives an opportunity to gather the women of different houses into one house and give them all lectures on a subject on which they need instruction. Sometimes, a demonstration lecture, such as preparation of food for the baby or any sick person, can be given. If mother or baby is sick the attempt is made to send them to the hospital promptly before empirical remedies are applied.

Planned Parenthood

Another great need of villages is family planning. This is not limited to keeping down family size but includes giving babies to those who do not have them, for there are a significant number of couples without children. Instead of consulting a trained physician, if one is available, they generally go on pilgrimages to different temples and perform all sorts of ceremonies and give to charities and so on. When there is no result the wife is in constant fear of being abandoned as sterile at the instigation of the mother-in-law, in addition to which there is a constant threat from the elders of the family that the husband will take another wife. Sometimes, such a second wife is congenial and life may move on smoothly. But usually there is jealousy between the two wives and constant warfare in the house, particularly if the newcomer proves to be fertile and the first continues to be sterile. The opposite circumstance is also found in the villages: poor people with far more children than they can afford to take care of. The village midwife is alert to this and quickly administers her crude drugs to induce abortion; as a result women die. If they survive they may become chronic invalids and constitute a real burden to the family. With these extreme conditions prevailing, family planning is a need vital to the health of the village community. As with people everywhere, objections to limiting family size arise. The health staff must be careful in planning this program to achieve real benefits and yet to avoid offensive activity.

Marriage Problems

Among the social problems that confront health workers in a village a common one is early marriage. In some villages, child marriages, even cradle marriage, is practiced. Too often the young couples are inexperienced, immature and not physically or mentally ready for marriage and children. The older people then direct them according to their own ways. A young woman, by the time she is thirty years old, may have had six to nine children and become weakened and prematurely aged.

Another marriage custom encountered in some parts of India is the practice of marrying near relatives. The girl may marry her mother's own brother, and in some families the girl marries her first cousin. Ordinarily, this kind of an alliance is entered into to preserve family wealth or land intact.

Discussion

To accomplish needed improvements in village health the full co-operation of the people is essential. The health staff should have friendly relations with the head man and other leaders. There should be consultation with them, and they should be made to understand the reasons why the reforms are needed. The health staff should not offend them, especially by attempting to change food habits. One should remember that "one man's meat is another man's poison," and that the modification of a dietary is made slowly and with patience.

The health staff should also be careful not to pass out destructive criticism but should have constructive plans to suggest. The members aim at making the villagers understand that they are their friends and well-wishers.

At this point the requirements of the health staff may be mentioned briefly. It is essential that the

members of the staff be able to talk the language of the area in which they work. India is a country of many languages. Unless the staff members understand the people and make themselves understood, little good can be accomplished.

Understanding the customs of the people in every way also helps. Compassion, sympathy and love for the people among whom one works go a long way and are rewarded with a good response. An arrogant attitude and looking down upon the poor villagers as dirty and ignorant constitute a grave mistake. Above all, the physician needs to take a missionary view of his work.

This article will be incomplete if a plan (based on personal experience) of an ideal health center is not suggested. It should be understood that this is not a hospital. The main aim of the work is prevention of disease and maintenance of health. To fall ill and to be cured is more costly than to maintain health by observance of health laws. There should be a spacious waiting room, where the patients can wait and where, in the evenings, lectures, audiovisual aids and demonstrations for mothers can be presented. There should be consultation, examination, treatment and dispensing rooms, as well as a delivery room and a few beds for maternity cases. A veranda in the front and back of the building will prove a valuable addition.

A suggested health staff for a health center includes a doctor with special training in public health, a public-health nurse and two generally trained nurses and maintenance staff. While the public-health nurse concentrates on the preventive side of the work the other nurses can help with curative work.

To answer the many calls from neighboring villages a jeep with four-wheel drive will prove highly useful on village roads.

Another vital aspect of this work concerns children of preschool age, who are numerous. When parents go away to the fields to work, the children are left under the care of slightly older sisters or brothers who themselves really need protection, care and schooling. The smaller children would be greatly benefited by a nursery school that could serve the dual purpose of education and day care. The older children should not be ignored, but there are still insufficient schools in rural areas.

To cultivate health education, a day is sometimes set apart as "health day," to be observed by all in the village. There may be special exhibits of charts and objects to depict a balanced diet, preparations for confinement, baby garments, a model house, a sanitary well, trained and untrained midwives and so on. Special meetings may be held, and health films may be shown. An important feature of "health day" may be a "baby show." The nurse can weigh the babies under her care, divide them into three groups — first six months, six months to a year-and-a-half, and one-and-a-half to three years — and have them examined and judged by the doctor and other nurses. Prizes may be then given. A fair is a good occasion for showing the people around the health center, and explaining its aims in detail. The school children may be encouraged to enter into essay competitions on health subjects. Boys and girls may be taught health dramas, and school teachers are encouraged to participate. It is they who will shoulder the main burden of molding and shaping the ideas of the villagers of the future.

MEDICAL PROGRESS

THE GROWING IMPORTANCE OF CARDIOVASCULAR RADIOLOGY*

FRED JENNER HODGES, M.D.†

ANN ARBOR, MICHIGAN

PHENOMENAL advances have occurred during the recent past in the diagnosis and treatment of cardiovascular disorders. Hand in hand, radiology and vascular surgery have provided a new and vigorous impetus to the conquest of hitherto unexplored fields with entirely new and highly specialized technics. In a brief span of years they have been developed to the point of great clinical utility. In the course of this development radiology has assumed a position of increasing importance in the management of patients who present cardiovascular problems.

The great changes that have taken place in cardiovascular radiology in the United States began abruptly in 1938 after the announcement by Robb and Steinberg[1] of their successful visualization of the cardiac chambers and the great vessels in human patients. Earlier published work by pioneers in Europe and in this country had somehow failed to initiate the wide interest and acceptance that, once awakened, has resulted in eighteen years of accelerating activity.

Two well documented appraisals of the relation of radiology to cardiology in this country are to be

*Based on the tenth George Winslow Holmes Lecture, "Current Potentialities of Cardiovascular Radiology," presented before the New England Roentgen Ray Society, Portland, Maine, May 20, 1955.
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found in the files of the *American Journal of Roentgenology and Radium Therapy*.[2,3] The scientific program for the thirtieth annual meeting of the American Roentgen Ray Society, held in New York, September 17-20, 1929, began with a heart symposium arranged by Dr. George W. Holmes.[2] This series of six papers, with introductory remarks by Dr. Holmes, together with recorded discussions, clearly relegated the various uses of radiologic methods to matters of position, size, shape and the external movements of the cardiac silhouette and the caliber, course and pulsations of the aorta. Evaluation of all radiologic methods available to the internist was offered by Dr. Paul D. White

TABLE 1. *Procedures for Radiologic Cardiovascular Diagnosis.*

VENOGRAPHY	ARTERIOGRAPHY	ANGIOCARDIOGRAPHY
Peripheral (extremities)	Peripheral (Extremities)	Venous
Intrathoracic	Intrathoracic	Selective
Intra-abdominal	Intra-abdominal	Direct via cardiac-wall puncture
Intracranial	Intracranial	

in his paper, "Observations on the Clinical Value of the Roentgen Ray in the Diagnosis of Cardiovascular Disease," in which he stated: ". . . roentgenology is but one of several clinical methods of studying the circulation . . . [and like the others] is incomplete in itself and . . . ranks down the list in value." In a later discussion he remarked:

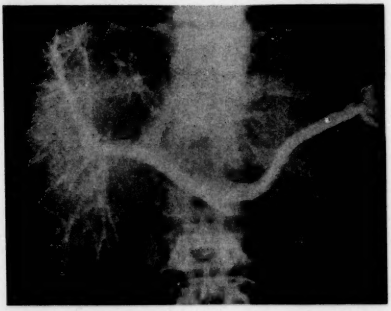

FIGURE 1. *Injection of Contrast Substance into the Spleen.*

> I presented, I confess in a rather pessimistic way, the views of many clinicians working on heart disease concerning the value of roentgen study at the present time. I think I am more interested, however, in the subject than are many internists and I believe there is a great deal of progress to be made . . . I am a very keen advocate of further roentgen study and progress. . . .

USE OF CONTRAST SUBSTANCES

Nine years later the same society listened to a progress report in the form of another symposium on heart disease arranged by Dr. Merrill C. Sosman for the thirty-ninth annual meeting at Atlantic City, September 20-23, 1938.[4] Once again six of seven papers dwelt upon information to be derived from observations of position, size, shape and contour pulsations of the shadows of the heart and great vessels, but the second paper of the symposium contained the

FIGURE 2. *Further Demonstration of Opaque Substance Injected for Splenoportography.*

keynote for the new developments shortly to follow. Drs. George P. Robb and Israel Steinberg, whose original work had already appeared in published form, thrilled the assembled roentgenologists with their report, "Visualization of the Chambers of the Heart, the Pulmonary Circulation and the Great Blood Vessels in Heart Disease." In discussing this memorable paper, Dr. Samuel A. Levine, of Boston, who earlier had remarked, "Heart specialists, I imagine, have needed the roentgenologists less than specialists in any major field of Medicine," was most enthusiastic over the portent of the newly described radiologic procedure. He said of this epoch-making piece of work:

> This is really the first big advance in roentgen diagnosis of the heart since the x-ray was discovered . . . From the clinician's point of view, it seems to me that this is a new era. It would be idle to speculate on how far this new development will go. We should either start doing it or watch for further developments.

Dr. George Holmes remarked:

> History has been made in cardiac diagnosis here to-day. I have never listened to a paper on the heart . . . that . . . offers more interest and more possibility for the future. . . .

The birth of the basic concept of using injected radiopaque material to render circulating blood visible had been recorded in print in this country fourteen years before the epoch-making presentation by Robb and Steinberg. Dr. Barney Brooks,[5] a surgeon, who described his successful intra-arterial injection of sodium iodide to produce peripheral arteriograms, was followed by others in Europe who experimented with injections of Lipiodol to the same end. In 1927

Egas Moniz,[6] in Portugal, first described "arterial encephalography," and Forsmann,[7] in Germany, successfully catheterized the right chambers of the heart in 1929. In the same year dos Santos et al.[8] showed that direct puncture and opaque injection of the abdominal aorta could be performed with safety and diagnostic advantage. Progress based upon these

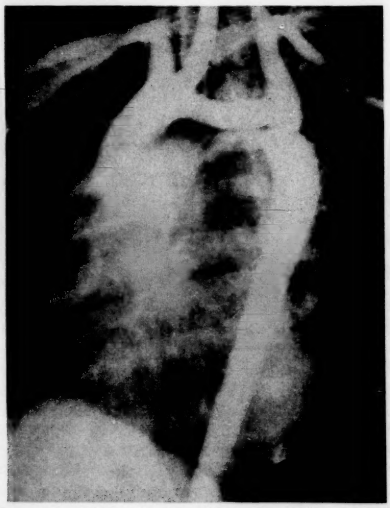

FIGURE 3. *Retrograde Injection of the Common Carotid Artery.*

early investigations received editorial attention in the *American Journal of Roentgenology* in 1931,[9] but the new approach to cardiologic problems with radiologic technics awaited the stimulus of the 1938 symposium in Atlantic City to receive active attention and intensive application.

The future of the new aspect of cardiovascular radiology, now in its eighteenth year since the Robb–Steinberg paper, is already well along in its development. Fulfillment of the forecasts of those outstanding men in radiology and clinical cardiology has in considerable degree been accomplished. In 1950 Dr. Merrill C. Sosman observed: ". . . the ultimate objective of all of these very complicated and sometime dangerous procedures is to learn enough about these conditions so that we can go back and refer that knowledge to the original, simple, uncomplicated examination and know more about what we are seeing and finding." To a large extent that was true when stated, and certainly the admonition to utilize newly gained information to the fullest advantage in the analysis of simply obtainable cardiovascular silhouettes is sound and wise. It must be admitted, however, that in its headlong, rushing development radiologic cardiology is disclosing important aspects of morphology and function that cannot be appreciated by simpler means, and at least some of these observations may well be of increasing importance as cardiovascular surgery continues to expand.

As of now, past the halfway point of 1956, radiologists have at their disposal an impressive group of technics for gathering remarkably detailed information regarding the circulatory apparatus, information of enormous value to cardiologists and cardiovascular surgeons. Many of these are in wide daily use, and others, which have appeared more recently, are finding wider clinical application daily. The refinement of accepted procedures and the exploration of still newer technics form the basis of an expanding field of basic and clinical research of great promise.

The new methods of cardiovascular radiology have a common characteristic, which is the addition of radiopaque material to the blood stream. Many such materials have been developed and extensively tested to meet rigorous standards of safety. The new pro-

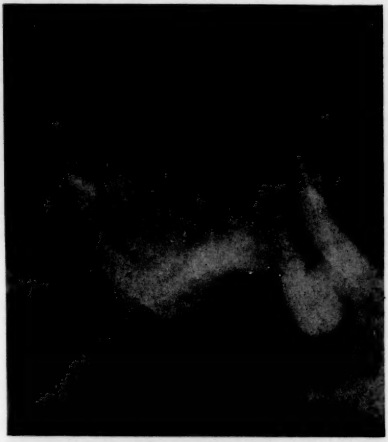

FIGURE 4. *Further Demonstration of Retrograde Injection of the Common Carotid Artery.*

cedures differ from one another according to the particular part of the vascular system to be studied, the site and method of opaque injection and the technic of observation. New demands for brevity and frequency of radiographic exposures have resulted in the development of novel and sometimes intricate apparatus, without which many of the procedures cannot be carried out.

PROBLEMS OF CARDIOVASCULAR RADIOLOGY

To be able to record at desirable stages of filling the exact appearance of vessels and cardiac chambers

filled with opacified blood, radiologists must be equipped with specially designed apparatus that in general is elaborate and expensive. Much is to be gained in the analysis of the successive filling and emptying of the cardiac chambers, for example, by simultaneous exposures of the heart in more than one plane. It is furthermore necessary to obtain extremely brief exposures to minimize blurring caused by movement of the blood and pulsations of the cardiac walls. Unless multiple exposures are obtained at brief intervals, information of prime importance may escape the observer. Brief exposures require the use of high-energy x-ray generators and switching devices of great accuracy and dependability. Great rapidity of film changing is an important requisite.

Devices and Equipment

These technical requirements have been met in a variety of ways. Several different mechanical devices for the rapid shifting of cut film in individual cassettes have been developed and marketed. Other instruments that feed roll film 20 to 35 cm. in width into proper position and then onto take-up spools have appeared, as well as others that rapidly shuffle naked cut film from light-tight storage into removable light-tight boxes. Successive exposures at rates of 1 to 12 frames per second can be obtained by direct radiography, and with some biplane instruments two tubes and two recording devices can be used simultaneously. Other devices are capable of single exposures as brief as one one thousandth of a second — fast enough to stop completely the movement of the blood stream.

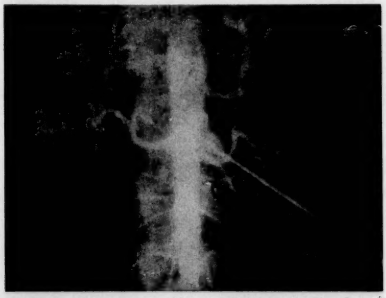

Figure 5. *Injection of Opaque Substance into the Abdominal Aorta.*

Recent achievements in the perfection of electronic image-amplifying instruments have made high-speed x-ray motion pictures possible and practicable. Exposure rates of 24 to 64 frames per second can be achieved with such equipment, allowing the examiner to observe circulatory incidents again and again in slow motion.

Because, to be effective, opaque material must be injected very rapidly to offset the dilution that occurs, rugged mechanical syringes powered with controlled gas pressure, interlocked electrically with film drive and x-ray exposure controls, have been developed. Newer and more effective grids are now available, without which image clarity would suffer particularly when simultaneous biplane exposures are used. Exposure programming devices that can be preset to alter the number of exposures per second for various phases of the circulatory cycle are available.

Figure 6. *Infusion of Opaque Substance into the Cerebral Vessels.*

Taken as a whole the mechanical and electrical advances in radiographic apparatus stimulated by the rapid growth of cardiovascular radiology have been extensive and complex. In direct parallel specially designed cardiac and vascular catheters, pressure recorders, instruments for rapid determination of oxygen saturation and for measuring the rate of blood flow have become available for collaborating cardiologists. The electrokymograph for rapidly and accurately recording movements has found an important field of usefulness. Surgeons who attempt hitherto unheard-of operations involving circulatory structures have access to mechanical extracorporeal hearts that permit them to lay open the interior of the heart under bloodless conditions. They have plastic prosthetic devices with which to replace diseased blood vessels, repair defective cardiac septums and substitute for nonfunctioning cardiac valves. Surgical instruments have appeared for incising deformed, nonfunctioning valve cusps, for nontraumatic clamping of vessels and for many other purposes of cardiovascular surgery.

All the time-tested conventional means of radiologic cardiovascular diagnosis are still available and, in the light of newer knowledge, are more valuable than before. The new graphic recording of circulating blood can for convenience be grouped into three major types of radiologic approach according to the part of the circulatory system being studied: venography; arteriography; and angiocardiography. Within

each of these major divisions are to be found procedures designed to learn particular facts (Table 1) and various specific technics.

Venography

By injection of a suitable opaque solution into peripheral veins of the wrist or ankle and partial or

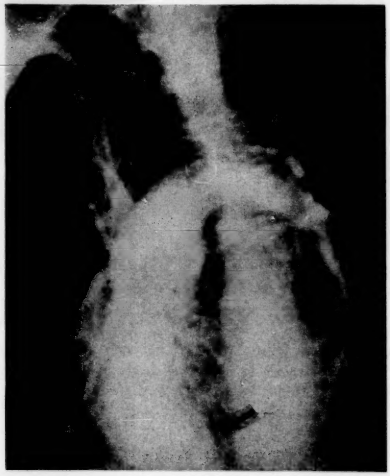

Figure 7. *Demonstration of Angiocardiography.*

complete occlusion of return at the axilla or groin, deep and superficial venous drainage of the extremities can be examined effectively for signs of intraluminal or extrinsic obstruction.

When the opaque material is introduced near the points where blood enters the thorax or the abdomen the status of the major tributaries of the superior or inferior venae cavae can be determined. This device can be particularly helpful in the explanation of intrathoracic lesions that have caused venous blockage in the upper extremities. At times unsuspected anomalies involving venous return to the right side of the heart come to light in the course of such examinations.

Percutaneous injection of opaque material directly into the substance of the spleen is now widely used as a means of determining the status of the portal circulation. This procedure is known as splenoportography (Fig. 1 and 2). Almost at once after splenic injection the opaque material begins to leave by way of the splenic vein to enter the portal vein and soon can be identified throughout the portal channels in the liver. Under normal circumstances no visible filling of other tributaries to the portal vein are seen, but if portal obstruction, either intrahepatic or extrahepatic in type, is present, this fact is expressed in more or less extensive filling of tributaries in which normal direction of flow is no longer possible. The pattern of the portal branches within the liver, normally uniformly delicate, is seen to be coarse and irregular in cirrhotic livers. Splenoportographic signs of cirrhosis are remarkably reliable. Blockage of the coronal vein with esophageal and gastric varicosities can be shown in spectacular form in many patients who present no radiologic evidence of the situation on gastrointestinal examination. Gross displacement or deformity of the splenic vein is sometimes observed in the presence of pancreatic lesions.

Under normal circumstances a few minutes after splenic injection opacified blood will be widely distributed throughout the parenchyma of the liver, causing the entire organ to cast an unusually dense shadow. Recognizable defects in the hepatogram can be produced by metastatic neoplastic masses or otherwise defunctionalized segments of liver. In patients who have undergone surgical anastomosis between the main portal vein and the adjacent inferior vena cava a subsequent splenoportogram will demonstrate the effectiveness of abolishing portal and

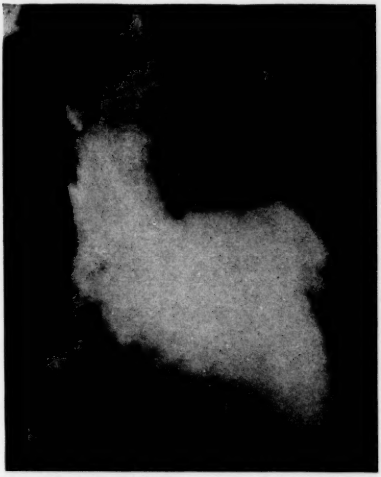

Figure 8. *Further Demonstration of Angiocardiography.*

splenic hypertension. The splenic infarct that follows this type of examination is not significant clinically, and the danger from extravasation has not been found to be a contraindication.

The venous phase of intracranial angiography, which occurs three seconds or more after the arterial introduction of opaque fluid, can provide enlightening information regarding abnormalities within the cranial vault. Frequently, visible filling of recognizable venous channels and minute capillaries within brain

tumors serve to outline such lesions with great clarity. Direct filling of the major venous sinuses has also been used effectively in the diagnosis of intracranial abnormalities.

Arteriography

Opaque injection of the axillary or femoral arteries in the direction of blood flow followed by brief exposures at relatively short intervals, with or without the use of partial venous occlusion by tourniquet, is useful in the detection, localization and evaluation of various manifestations of occlusive arterial disease. Valuable information regarding peripheral aneurysms and arteriovenous communications can be obtained in this way. Some progress has been made in the evaluation of bone and soft-tissue tumors by study of the details of tumor circulation. This technic also provides a means of observing various vascular disturbances in the feet and hands.

Retrograde injection, against blood flow, of the common carotid artery by direct puncture or catheter or by catheter inserted in the radial artery and directed toward the heart (Fig. 3 and 4) is a useful and effective means of showing aneurysms of the major branches of the proximal aorta within or just outside the thorax. When the catheter tip is placed in the lumen of the aorta by way of one of its principal branches the entire arch can be seen in brief, properly timed x-ray exposures. This yields the most brilliant and detailed evidence of aortic coarctation at the common site, for high density of the injection mass can be maintained during filming.

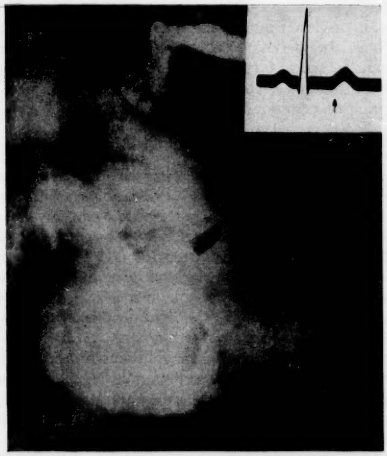

Figure 9. *Further Demonstration of Angiocardiography.*

Radiographic conquest of the abdominal aorta and its distributing branches has brought to light many situations of great clinical importance some of which, when the details are known, are now amenable to surgical correction. Abdominal aortography (Fig. 5) can be carried out by direct percutaneous puncture through the back to the left of the spine above the position of the renal arteries, by long-catheter insertion from above or from below. Each technic has its particular indications, and various radiologists and surgeons have their personal preferences. All methods are safe in the hands of trained and careful operators. It is a thrilling experience to be able to identify the lumen of the entire abdominal aorta and all its major branches in a single large roentgenogram. Degrees of selective filling can be accomplished by the careful placement of catheters. The course and distribution of the renal arteries in normal persons and in those with anomalous branching, with renal neoplasms and other intracapsular masses, is readily seen. In nephrograms showing the generalized opacification of the kidneys that shortly follows arterial perfusion, the true size and shape of the kidneys can be determined, and bloodless segments of whatever nature are clearly visible. This procedure is often of great help in the discovery and identification of suprarenal tumors. Aneurysms of the renal and splenic arteries, unrecognizable by ordinary x-ray methods unless they happen to be heavily calcified, are readily apparent.

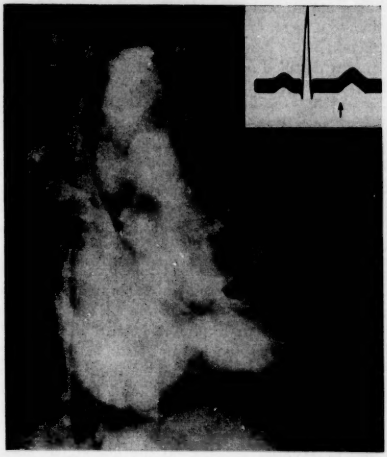

Figure 10. *Further Demonstration of Angiocardiography.*

Not only can aneurysms of the abdominal aorta be differentiated with certainty from nonvascular masses but also the extent of thrombosis and canalization can be observed with clarity. If the aorta has purposely been filled at a sufficiently high level the true identity of suspected pulmonary sequestration can be proved,

and the thoracic surgeon can be advised in advance of operation of the exact location of the anomalous arterial branch underlying this unusual lesion.

It is in the evaluation of occlusive arterial disease that abdominal aortography and the associated visualization of the iliac and femoral arteries finds its greatest practical application at the moment, for an accurate and detailed advance description of the location, nature and extent of luminal obstruction permits the surgeon to plan and execute operative reconstruction of the damaged stream bed in many patients formerly destined to rely solely upon what relief lumbar sympathectomy might offer. On the basis of definitive radiologic evidence the surgeon may plan and execute topical or extensive endarterectomy or grafting with material from the artery bank or with a plastic prosthesis. Recorded findings by the same diagnostic technic after surgical treatment have shown spectacular resumption of normal blood flow and the virtual disappearance of previously well developed collateral vessel channels.

In Sweden, where all sorts of angiographic methods have been extensively studied, elaborated and clinically employed,[10] selective opaque perfusion of the uterine and ovarian arteries has been developed.[11] To accomplish this end a thin plastic catheter is inserted through a relatively large femoral-puncture needle, which is then removed, and its tip placed near the origin of the uterine artery. The location is confirmed by small trial injections. By the application of external pressure on the abdominal aorta above and the femoral arteries below, circulation is slowed and injection into the femoral catheter accomplishes fill of the uterine as well as all other arteries arising from the upper part of the femoral. Early and delayed films are exposed, the former identifying the uterus and the latter showing, in cases of tubal or intrauterine pregnancy, persistent filling of characteristic placental lakes to identify the location of the placenta.

In this country x-ray examination of the cranial contents after opaque perfusion of cerebral vessels (Fig. 6) has been in wide clinical use longer than any other form of angiography. Several modifications of the basic procedure have found favor in various clinics. These differences have to do with methods of injection and technic of filming. In general, percutaneous puncture of the common carotid artery the rapid injection of 10 to 12 ml. of 50 per cent Diodrast and two short exposures in lateral projection, one at the end of injection to record purely arterial filling and the other made three seconds later to record filling of venous channels, is the procedure of choice followed by direct anteroposterior filming when a second injection has been made. Compression over the external carotid artery causes the bulk of opaque substance to follow the course of the internal carotid artery. Resulting films show the course of the internal carotid artery on the injected side, including its major anterior and middle cerebral branches. Occasionally, the posterior cerebral vessel will be filled, in about 15 per cent of patients; it can be filled if one so desires by injection of the vertebral artery, which is its major source of blood. One can prepare stereoscopic films for three-dimensional viewing simply by repeating injection after suitable shift of the x-ray tube. High-speed film changers and cinephotofluorographic apparatus can be used to record step-by-step flow of blood through the cerebral vessels.

Cerebral angiography finds great clinical usefulness in three major directions. The presence, location and sometimes the nature of space-occupying masses in the cerebral hemispheres or between them and the cranial wall can be deduced from resulting distortion and displacement of the cerebral vessels. Purely vascular lesions, such as aneurysms, arteriovenous anomalies and arterial occlusions, are graphically shown. Sometimes, the delicate vessels within a brain tumor may remain filled longer than normal arteries, imparting a faint density to the mass. This is known as "tumor stain."

Compared with other approaches to the x-ray diagnosis of intracranial lesions, cerebral angiography ranks as less traumatizing than aerographic procedures. It does not replace air encephalography or ventriculography for all purposes, but it will often be the method of choice. It is not useful in the localization of posterior-fossa or brain-stem lesions.

Angiocardiography

The application of x-ray methods to the study of blood flow through the chambers of the beating heart (Fig. 7-10) represents the most thrilling and the most complex of all angiographic procedures. As this technic was first practiced, opaque material was introduced very rapidly by way of the antecubital vein, followed by serial exposures of the heart to record its appearance in the right chambers, the pulmonary circuit, the left atrium and ventricle and lastly the aortic arch and its main subdivisions. When this plan is followed, the resulting radiographic images constitute a "venous angiocardiogram." In contrast, the introduction of long cardiac catheters by way of the veins of the upper or lower extremity to a particular site within the heart for the delivery of opaque fluid constitutes "selective angiocardiography." Each has its advantages, depending on the specific information that is sought. More recently, again for specific reasons, the introduction of opaque material by direct puncture of cardiac walls has found a place of potential usefulness.

At the outset angiocardiography was used to confirm suspected congenital structural defects and to record detailed anatomic characteristics of individual situations. The need for some such device was apparent as an adjunct to cardiac-catheterization technics that were being used to plan available surgical operations for the correction of patent ductus ar-

teriosus and the pulmonic stenosis of tetralogy of Fallot. When the surgical correction of aortic coarctation became feasible, angiocardiograms in the late phases proved useful. Perhaps the greatest virtue of angiocardiography was its ability to uncover unsuspected congenital faults that contraindicated the forms of surgical treatment then available.

Actually the ductus arteriosus may be patent without detectable angiocardiographic sign, but if suitably brief and rapidly successive exposures are used, the visible flow of dense blood through the undivided pulmonary artery may be seen to undergo interruption momentarily when diastolic aortic pressure exceeds diastolic pulmonic pressure, allowing the pulmonary artery to be flooded with nonopaque blood and thus becoming less opaque. Tetralogy of Fallot ordinarily makes itself quickly apparent, for the defect high on the interventricular septum permits the pulmonary artery and the ascending aorta to fill simultaneously early in the cycle, and poststenotic dilatation of the pulmonary artery is obvious despite decreased blood content in the smaller pulmonary branches.

Vascular Anomalies

Vascular anomalies from simple right-sided aorta and true dextrocardia to persistent fetal arches, absence or malposition of aortic-arch branches or complete vascular transportation can be shown by angiocardiography. Partial or complete transposition of major veins leading to the atria can be recognized. Septal defects occurring alone or as a part of more extensive malformations are recognizable by premature spread of the injection mass from the right to the left chambers or by dilution of material in the right side of the heart with nonopaque blood from the left. Profound congenital faults such as cor triloculare can be differentiated from less complex causes for circulatory difficulty.

Acquired Cardiac Lesions

With the rapid perfection of technics of cardiac surgery, much more commonly encountered acquired lesions are now being studied with angiocardiography — for example, the character and magnitude of valvular defects and the demonstration of intracardiac tumors. Now that the direct surgical repair of septal defects has become possible, angiocardiographic means of determining the location and the size of such openings becomes important. It is possible with the new technics to differentiate valvular from infundibular pulmonic stenosis.

Anomalies of the pulmonary arteries such as congenital arteriovenous communications can be demonstrated easily, often showing that such defects are multiple and present in both lungs whereas only one may have been detected in standard chest films. Angiocardiography has proved useful in differentiating vascular and nonvascular mediastinal masses.

In the presence of pericardial effusion, sometimes difficult to differentiate from gross cardiac dilatation, by visualization of the cardiac cavities the true state of affairs is made clearly apparent. This is also true for pericardial tumors.

Future Promise

There are clear indications that the part of radiology in the realm of circulatory physiology and clinical cardiology is destined to continue to expand in extent and importance. Perfection of present technics and apparatus and the development of new applications and new devices goes on at a rapid pace. Much can yet be expected from the combination of cardiac catheterization, electrokymography, electrocardiography and the refinements of angiography. Catheters equipped with one or more balloons to be inflated to fix the site of injection have been employed to permit highly selective localization of perfusion fluids to particular organs or tissues. Some steps have already been taken toward the selective perfusion of the liver, one or both kidneys and even the pancreas with x-ray-opaque fluids. With a simple balloon catheter, obstructive injection of one pulmonary artery in toto or in part is feasible. The delivery of carcinocidal materials to individual organs has been accomplished, and the possibility of combining this technic with the use of external radiation with neutrons to produce topical radiation by neutron capture by boron[10] is enticing. Knowledge that has come to light regarding exact circulatory physiology will undoubtedly be expanded materially as the new technics continue to be more widely employed.

The confidence in future developments in cardiovascular radiology expressed in 1929 by Dr. Paul Dudley White and by Dr. Samuel A. Levine in 1938 was well founded. The great advances of the past eighteen years have by no means exhausted the possibility of far larger achievements to be expected in the years ahead, for cardiovascular radiology shows every indication of continuing growth and expanding importance.

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MEDICAL INTELLIGENCE

ACUTE DISSECTING ANEURYSM OF THE AORTA

Operation, with Recovery

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KNOXVILLE, TENNESSEE

DISSECTING aortic aneurysm is reported to result in death in more than 80 per cent of cases during the early or acute stage of the disease. The available literature has been reviewed by Shaw[1] and by DeBakey, Cooley, and Creech.[2] Because of the rapidly fatal course of the disease and the mechanical nature of the lesion, Johns[3] has emphasized the fact that the problem should be considered a surgical emergency.

Four previous reports of patients operated upon during the acute phase of the disease have recorded failures. Three of the patients died of renal failure,[1,3,4] and 1 of external rupture of the aneurysm into the pericardial sac.[2]

In the following case of dissecting aortic aneurysm the patient was operated upon early in the course of the disease, with survival and apparently complete recovery.

CASE REPORT

A 47-year-old man was previously well and working as an auditor until the day of admission to the hospital. While driving his automobile he felt a sharp pain originating substernally and in the neck. The pain extended into the left shoulder and later into the left upper arm. It gradually became more severe and shifted downward into the back in the interscapular region.

He was admitted to the hospital at 3 p.m. and received morphine, 8 mg. (1/8 gr.), intravenously without relief of the pain; 15 mg. (1/4 gr.) of morphine was then given subcutaneously. He continued to complain of pain and assumed a knee-chest position, with his neck markedly flexed, in the belief that this position gave him some relief.

The electrocardiogram was within normal limits. X-ray examination of the chest revealed a slight flattening and irregularity of the aortic knob and was otherwise not remarkable. Demerol, 50 mg., was given intravenously and Sodium Luminal, 0.12 gm. (2 gr.), subcutaneously at 6 p.m. The pain was somewhat better, but continued to be agonizing. When the patient was seen in surgical consultation at 9:30 the blood pressure was 140/80 in the right arm and 120/70 in the left arm. No murmur was audible over any part of the thorax. Pulsations in the lower extremities were palpable and were equal. A voided specimen of urine was not abnormal. He localized his pain at this time in the left aspect of the chest posteriorly just below the angle of the scapula near the spine. A preoperative diagnosis of dissecting aneurysm was made, mainly on the basis of the history, and operation was undertaken.

An anterior incision was made over the 4th intercostal space and carried from the middle of the sternum to the axilla. Exposure of the aorta revealed a slight purplish discoloration of the vessel beginning just proximal to the left subclavian artery and extending about 10 cm. distally. Because it appeared unsafe to open the descending aorta from this anterior approach, the patient was turned on the right side, and the anterior thoracotomy incision was extended posteriorly around the left scapula.

The descending thoracic aorta was mobilized in its proximal half and crossclamped with Pott's ductus clamps. A longitudinal incision, 8 cm. in length, was made in the aorta between the clamps. With the edges of this incision spread, the diagnosis of dissecting aneurysm was further confirmed, and the lesion was visualized. The intima, together with part of the media, was elevated on the posteromedial wall, much as a mole would raise the turf of a lawn. A window, measuring 2 by 3 cm., was cut from this elevated portion of the intima and media (Fig. 1). The space beneath contained blood, which did not appear to be clotted. The distal edge of the elevated intima and media was sutured firmly back in 1 layer by passing of mattress sutures through the entire wall of the aorta and tying of the sutures exteriorly. The proximal elevated portion of the media and intima were left elevated and not disturbed except for aspiration of blood from within. The aortic incision was closed. The clamps were removed from the aorta after 14 minutes and 55 seconds. During crossclamping of the aorta the systolic blood pressure in the arms rose as high as 230. The blood pressure returned to normal levels when the clamps were removed and did not fall further. To reinforce the aortic

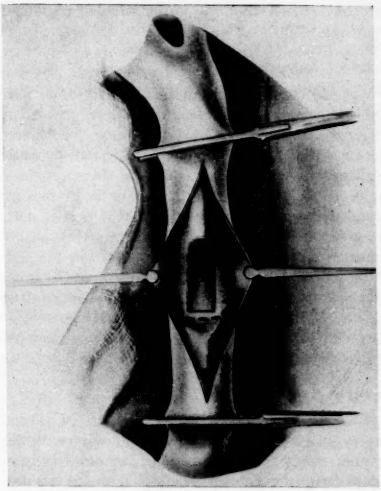

FIGURE 1. *Operative Approach, Showing the Longitudinal Incision in the Crossclamped Aorta.*

A window or fenestration is made in the dissected layers proximally to rechannel the blood into the normal aortic lumen. Distally, all layers are reapproximated by suture to halt further progress of the dissection.

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incision and to reinforce as much of the dissecting aneurysm as possible, a piece of nylon taffeta, about 10 cm. in length, was cut in a fashion to encircle the aorta and sutured in place.

The postoperative course was relatively uneventful. Anticoagulant drugs were not used. The urinary output was within normal limits. Daily examination of the lower extremities revealed no obvious neurologic or vascular abnormality.

On examination 6 months after discharge from the hospital the patient appeared well. He had no chest pain or other complaints. The blood pressure was 140/90 in both arms. Pulses in the extremities were normally palpable and equal bilaterally. X-ray study of the chest revealed no enlargement of the aortic silhouette. He has returned to his work as an auditor.

Summary

Successful surgical treatment of a patient with acute dissecting aortic aneurysm is reported. The interval between onset of symptoms and surgery was about nine hours. The patient was well 6 months after surgery.

The method of management consisted of fenestration of the internal wall of the aneurysm to direct the blood back to the normal aortic lumen and reapproximation by suture of the vessel layers distally to prevent further dissection. In addition, the diseased aorta was strengthened and reinforced by external wrapping with nylon cloth.

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DOCTORS AFIELD

Thomas Campion (1567-1620)

H. E. Shister, M.D.*

MONTREAL, QUEBEC

THOMAS Campion (or Campian) — physician, poet and composer — was well known and esteemed during his lifetime, but shortly after his death his work fell into complete oblivion for almost three hundred years. It was only toward the end of the nineteenth century that A. H. Bullen, a distinguished scholar of Elizabethan literature, re-established Campion to his well merited position. A complete edition of the poet's works by Percival Vivian appeared in 1909. It was his meticulous research that clarified many biographic points and succeeded in presenting a well balanced appreciation of this outstanding personality.

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Campion was born in London on February 12, 1567, the son of John Campion (a member of the legal profession) and Lucy Searle. In 1580 he entered Peterhouse, Cambridge, as a Gentleman Pensioner. It was here that his knowledge and love of classical literature began. He left the University in 1584 without taking any degree. In 1586 he was admitted to Gray's Inn — apparently to embark upon some legal career. Here he formed numerous friendships and participated in the prevalent gay functions, such as presentation of masques and plays. He remained there until 1591, when, as some indirect evidence shows, he joined an expeditionary force to France as a Gentleman Adventurer and presumably participated in the siege of Rouen. Upon his return he stayed at Gray's Inn for another two years — that is, until 1595.

The next and decisive part of his studies concerned his choice of a medical career. It is not known exactly where he obtained his medical degree, but he must have done so in some school on the Continent in the years 1602 to 1606. After 1606 references to him as a practicing physician are frequent. He died on March 1, 1620, of the plague (this has been suggested but not absolutely proved). There is no evidence of his being married.

He is described as a lean man of warm disposition, impetuous in temperament, and an intellectual eccentric. He was well known in many circles and highly respected. Vivian describes him as an impetuous youth who freely participated in the extravagances of Elizabethan London but who outlived these excesses and settled down to a gentle mode of life, devoting himself to the pursuit of poetical and musical activities as well as the practice of medicine. His loyalty to his friends is continuously being stressed — when he died he left his entire (if not enviable) estate of £22 to the lutanist, Philip Rosseter.

Although sporadic verses appeared as early as 1595 and 1597 the first publication of importance is *A Booke of Ayres* (in conjunction with Philip Rosseter, 1601). Then came *Two Bookes of Ayres* (1613) and *Third and Fourth Bookes of Ayres* (1617), as well as *Songs of Mourning — on the Occasion of Prince Henry's Death* (1613) and *Ayres for the King's Entertainment* (1618). There are also the Latin verses — *Epigrammatum, Umbra* and *Elegiarum Liber* (1619). In addition he wrote four masques with music: in honor of Lord Hayes and his bride (1607); an entertainment for Queen Anne (1613); for the marriage of the Count Palatine (1613); and for the marriage of the Earl of Somerset (1614). Two theoretical works are also available; one is *Obseruations in the Arts of English Poesie* (1602), a controversial work dealing with problems of metric verse, and the other is a musical dissertation, *A New Way of Making Fowre Parts in Counterpoint* (1618).

Campion left no medical writings by which we can form an evaluation of his professional activities. Indirect sources suggest that he was well known as a practitioner, and a poem in John Davies's *Scourge of Folly* (1610-11) attests to the excellent opinion that his contemporaries had of him:

TO THE MOST IUDITIOUS AND EXCELLENT
Lyrick-Poet Doctor Campion.

...
So thou canst cure the Body and the Minde,
(Rare Doctor,) with thy twofold soundest Arte;
Hippocrates hath taught thee the one kinde,
Apollo and the Muse the other Part:
And both so well that thou with both dost please
The Minde, with pleasure; and the Corps, with ease.

But if he left no medical writings behind him, posterity was well compensated by a rich contribution of lyrics and musical compositions. It is well recognized that the English lyric obtained a high level of excellence during the sixteenth and seventeenth centuries; it is equally true that the same period is in many ways the purple patch of English musical history. "Neat and spruse ayres" were heard alike in royal palaces, middle-class homes and the smallest villages. It was truly an era that could pride itself on an excellent song of the people.

Among the most talented and often quoted song writers are Byrd, Dowland and Morley, but Campion exhibited a perfect fusion of poetical and musical gifts and must, in many ways, be regarded as the greatest of them all.

The interesting point is that Campion's poetry can be enjoyed entirely apart from his music, for it has a rhythmic validity and grace of its own. What was the nature of his poetry? What range of subjects did he treat? Briefly, all the emotional elements used are for the creation of poetical experience solely, not for intellectual or moral purposes. He was very successful in his sacred lyrics (a rare trait among English poets, according to Bullen) and it is said that "Out of My Soules Deapth" is the best versified psalm (*De Profundis*) in English. His principal theme, however, is a sincere, unconventional love song. Here he really shines. Unlike some of his contemporaries he would not have any laborious versification. His musical proclivities probably had a great deal to do with the fluid, rhythmic quality of his verse, which, even when separated from the music, remains entirely melodious and full of varied cadences. The text is always lucid, and the diction charming.

In his address at Oxford, Bullen beautifully summarized the greatness of this poetry:

> There are no songs in our language more graceful, happy and unconstrained — with more melody and magic — than many that we find in Campion's song book . . . Whatever he essays to do he does well; he always finds the true and inevitable word for a love song or a hymn. He was at once a born singer and a consummate artist.

The Latin verses command little attention today. They are chiefly valuable because of the light they cast on his friendships and loves, and because they afford a good insight into the poet's own personality. The principal value of his masques lies not in the dramatic contribution (far inferior to those of Ben Jonson's, for example) but in their purely lyrical qualities and in the music he composed for some of these entertainments.

The two works in prose form should be mentioned. *Obseruations in the Arts of English Poesie* deals with the problems of nonrhymed verse; it provoked some polemic literature in his time. The other treatise, *A New Way of Making Fowre Parts in Counterpoint*, was sufficiently famous to have gone through two editions (1655 and 1664) and has been used as a standard textbook.

At present Campion's position in the world of art is sufficiently secure. His poems are found in well edited anthologies. One standard book (M.M. Kastendieck's *England's Musical Poet, Thomas Campion*) and a large number of critical essays by British and American authors are in existence; indeed, some of these form very stimulating reading. Dr. T. K. Munro, of Glasgow, includes him among the galaxy of celebrated physicians who excelled in various other fields of endeavor (*The Physician as Man of Letters, Science and Action*). Finally, one notes with great satisfaction that such distinguished modern composers as Ralph Vaughan Williams, John Ireland, Peter Warlock, Sir H. Davies and others find inspiration in Campion's texts and set some of his poems to their own music.

It is perhaps pertinent, in these days of widespread use of recorded music, that Campion's works should be made available for immediate enjoyment. Such beginnings can already be discerned, thanks to the efforts of the renowned English countertenor, Alfred Deller (Vanguard recording, Bach Guild No. 539), and the History Division of the Deutsche Grammophon Gesellschaft (Archive Series, Record No. 3004).

It is quite obvious now that it was no matter of exaggeration when Swinburne, in congratulating A. H. Bullen on issuing (1888) the first edition of Campion's works, wrote: "you have added a name to the roll of English poets, and one that can never be overlooked. Certainly his long neglected ghost ought now to be rejoicing in Elysium." For all modern evaluations agree that the neglect of the works of this "seraphic doctor of English prosody" left an important gap in English lyrics and Elizabethan music.

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CASE RECORDS
OF THE
MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

BENJAMIN CASTLEMAN, M.D., *Editor*

VIRGINIA W. TOWNE, *Assistant Editor*

CASE 42271

PRESENTATION OF CASE*

First admission. A twenty-six-year-old man entered the hospital because of a headache.

For six months before admission he had noted loss of "pep." Three days before admission there was a sudden onset of dizziness, with the development of stiffness of the neck. This was followed by severe, throbbing headache that increased in severity in spite of sulfonamide therapy.

Six years before admission the patient had been rejected for military service because of a heart murmur. A tooth had been extracted two months before admission. There was no history of rheumatic fever.

Physical examination showed a well nourished man complaining of an occipital headache. Ophthalmoscopic examination revealed blurring of the optic disks. There was slight stiffness of the neck. The heart was not enlarged. At the apex a loud, harsh systolic murmur was audible; one observer heard a short, late diastolic murmur.

The temperature was 99.6°F., the pulse 74, and the respirations 16. The blood pressure was 120 systolic, 80 diastolic.

The urine was normal. Examination of the blood revealed a hemoglobin of 16 gm. per 100 ml. and a white-cell count of 9900. A blood Hinton test was negative. An x-ray film of the chest was normal (Fig. 1). On lumbar puncture 10 ml. of cerebrospinal fluid having the appearance of ground glass and under a pressure equivalent to 140 mm. of water was obtained; the cell count was 950, with 37 per cent neutrophils, 59 per cent lymphocytes and 4 per cent monocytes; the total protein was 60 mg., the glucose 43 mg., and the chloride 63 mg. per 100 ml.; culture showed no growth.

*Presented at the meeting of the New Jersey Heart Association, Newark, New Jersey, March 14, 1956.

On the sixth hospital day a dusky-red, tender area developed in the terminal interphalangeal fold of the right fifth finger. Blood cultures on the seventh, eighth and eleventh hospital days grew out alpha-hemolytic streptococci sensitive to penicillin. With a three-week course of penicillin therapy the temperature and white-cell count were maintained at normal levels, and subsequent blood cultures were negative. On the twenty-sixth hospital day the cerebrospinal fluid was normal. The patient was discharged asymptomatic on the fortieth hospital day.

Second admission (ten years later). He remained asymptomatic without therapy until four and a half years before entry, when he noted slight dyspnea on exertion or when climbing one flight of stairs. One year later there were several episodes of his coughing up blood-tinged sputum. Physical examination showed slight pallor and no distention of the neck veins. Examination of the lungs was negative. The point of maximum cardiac impulse was 2 cm. to the left of the midclavicular line in the sixth intercostal space. The second aortic and pulmonic sounds were equal. A Grade 3 apical systolic murmur was heard over the precordium, a Grade 1 to 2 diastolic rumble with a presystolic crescendo along the left sternal border, and a Grade 1 to 2 systolic murmur transmitted to the neck at the base. There was no ankle edema. The blood pressure was 120 systolic, 80 diastolic. An electrocardiogram showed a normal sinus rhythm at a rate of 95; the PR and QRS intervals were 0.19 and 0.08 second, respectively; the voltage and axis were normal; the R waves were somewhat increased in Leads V_5 and V_6; the P waves were 0.13 to 0.14 second in Lead 2; the RS segment was normal; the T waves were upright in Leads 1, 2, aVL, aVF and V_1 through V_6 but unusually low in Leads

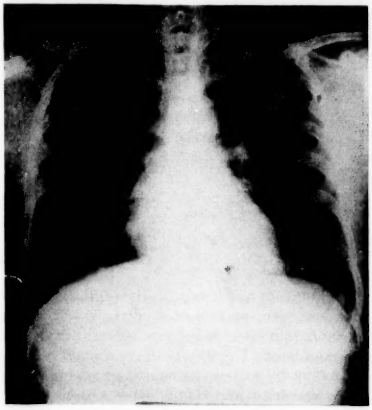

FIGURE 1.

V_5 and V_6. The dyspnea was relieved with digitalization, but subsequently there was nocturnal dyspnea. Two months later blood-tinged sputum was again noted, with coughing associated with exertional dyspnea. At this time examination of the lungs revealed many rales and rhonchi over the right lower lung posteriorly. X-ray films of the chest showed enlargement

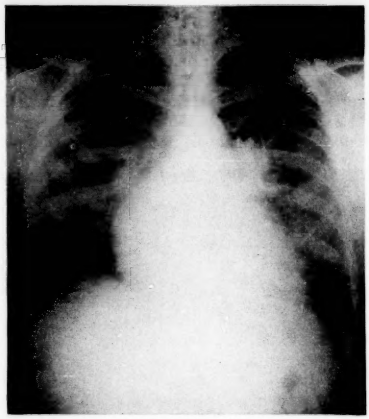

FIGURE 2.

of the left atrium and ventricle; the pulmonary vascular shadows were prominent, and there was a glassy appearance in both middle-lung fields; the azygos vein appeared dilated (Fig. 2). With continuation of digitalis therapy the patient remained asymptomatic except for coughing and slight blood streaking of the sputum associated with more than routine exertion. The previously noted mitral diastolic rumble was an inconstant finding, but the diastolic blow heard along the left sternal border, as well as the other cardiac signs, remained. Two and a half years before admission there were two episodes of hemoptysis associated with slight pain in the right lower portion of the chest. About two years before entry, because of fatigue, weight loss, fever and generalized aches he was treated by his physician with penicillin and dihydrostreptomycin by mouth over a period of four months. After two weeks of convalescence he was given a more sedentary job. Except for dyspnea after climbing one flight of stairs and orthopnea relieved by two pillows, he remained asymptomatic on digitalis therapy and a low-salt diet. Six to eight weeks before admission there was an abrupt onset of progressively increasing dyspnea, orthopnea and ankle edema, which persisted in spite of increased digitalis, diuretic therapy and aminophylline.

Physical examination showed a fatigued, markedly orthopneic, dyspneic man who appeared chronically ill. There was poor oral hygiene. The neck veins were distended halfway to the jaw but not pulsatile when the patient was raised 30°. Examination of the chest revealed wheezes and musical rales bilaterally. The left border of cardiac dullness extended to the midaxillary line; the right border extended 11 cm. from the midsternal line. The cardiac rhythm was grossly irregular. There was an apical thrill, with a harsh Grade 4 systolic murmur that was transmitted over the precordium and to the back, a high-pitched Grade 2 diastolic murmur in the fourth left intercostal space, a low-pitched Grade 1 diastolic rumble at the apex and a Grade 1 aortic systolic murmur transmitted to the neck. The liver, which was firm, tender and nonpulsatile, was palpable 10 cm. below the right costal margin. The spleen was questionably enlarged, extending 2 fingerbreadths below the left costal margin. There was pitting edema of the ankles, legs and thighs.

The temperature was 100°F., the pulse 92 and irregular, and the respirations 26. The blood pressure was 110 systolic, 60 diastolic.

The urine was normal. Examination of the blood revealed a hemoglobin of 13.1 gm. per 100 ml. and a white-cell count of 12,150. The sedimentation rate was normal. The serum nonprotein nitrogen was 27 mg., the bilirubin 0.8 mg., the total protein 6.8 gm., the albumin 4.2 gm., the globulin 2.6 gm., the creatinine 0.95 mg., and the fasting blood glucose 122 mg. per 100 ml. The serum sodium was 135 milliequiv., the potassium 3.8 milliequiv., the carbon dioxide 26 milliequiv., and the chloride 93 milliequiv. per liter. Cephalin flocculation was + +. The creatinine clearance was 59 liters per twenty-four hours. Blood cultures on the second, tenth and twelfth hospital days were negative. A throat culture grew out abundant alpha-hemolytic streptococci and a few nonhemolytic streptococci. X-ray films of the chest showed massive cardiac enlargement involving all chambers; the carina was displaced upward by the enlarged left atrium; the lung fields were slightly congested (Fig. 3). At fluoroscopy cardiac pulsations could be seen in all areas although the amplitude was decreased; there were normal diaphragmatic excursions. An electrocardiogram showed atrial fibrillation, with a ventricular rate of about 100; the QRS interval was 0.09 second; the axis was normal; depressed or sagging ST segments were noted in Leads 1, 2, 3, aVF, V_5 and V_6.

On the seventh hospital day there was a transient episode of nonradiating substernal chest pain. An electrocardiogram showed no significant change. In spite of digitalis therapy, a low-sodium diet, mercurial diuretics and restriction of fluids the signs and symptoms remained unchanged except that the temperature returned to normal. An x-ray film of the chest on the twenty-first hospital day showed no significant changes. Because of the persistent edema Southey tubes were inserted for thirty-six hours, with removal of considerable edema fluid. Penicillin therapy was

begun and continued throughout the hospital course. On the twenty-sixth hospital day a bilateral superficial-femoral-vein ligation was performed; no thrombi were found at operation. Supplemental potassium chloride and ammonium chloride were given. On the day after operation the serum sodium was 130 milliequiv., the potassium 9.7 milliequiv., and the chloride 94 milliequiv. per liter. The serum nonprotein nitrogen was 53 mg. per 100 ml. Later during this day there was a severe pleuritic type of pain, with localized tenderness that persisted for about five days over the left-lung base posteriorly. An inconstant friction rub was subsequently audible in this region. An x-ray film of the chest demonstrated a triangular area of infiltration at the left-lung base. On the thirty-third hospital day the serum sodium was 125 milliequiv., the potassium 6.4 milliequiv., and the chloride 84 milliequiv. per liter. The serum nonprotein nitrogen was 47 mg. per 100 ml. With a more liberal salt intake and restriction of fluids and potassium the serum nonprotein nitrogen and electrolytes were restored to normal values. A subsequent creatinine clearance was 100 liters per twenty-four hours.

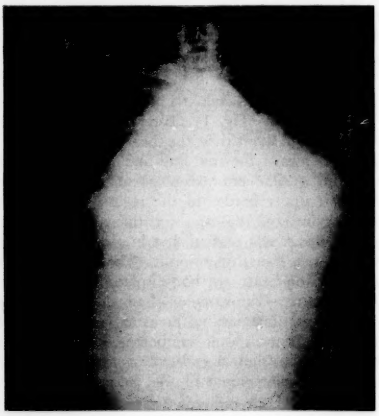

FIGURE 3.

An abortive attempt at Dicumarol therapy was started on the twenty-eighth hospital day, but the prothrombin content was never within the therapeutic range. Edema fluid reaccumulated in the thighs and legs. Transient swelling and tenderness of the right wrist occurred on the thirty-fifth hospital day. With salicylate therapy, 4.5 gm. daily, the temperature continued to be normal, and the sedimentation rate ranged between 33 and 36 mm. per hour. The antistreptolysin titer was 125 units. On the thirty-sixth hospital day pain in the right calf and along the medial aspect of the right thigh was noted. Three days later a transient apical pericardial friction rub became audible. An electrocardiogram showed atrial fibrillation, with a ventricular rate of about 70; the QRS interval was 0.08 second; the axis was normal; the ST segments were depressed and sagging in Leads 1, 2, 3, aVL and aVF, with diphasic T waves; the ST segments were depressed in Leads V_4 through V_6. On the forty-second hospital day the patient complained of low-back pain that radiated anteriorly to both sides of the abdomen and lasted for about a week. X-ray films of the lumbar spine and an intravenous pyelogram were normal. Intermittent pain in a molar tooth was noted on the forty-fifth hospital day. X-ray films of the teeth showed no apical abscesses. The blood salicylate on the fifty-fourth hospital day was 15.5 mg. per 100 ml.

The patient was discharged improved on the fifty-seventh hospital day on a low-sodium diet, a restricted fluid intake, ammonium chloride, potassium chloride, digitalis, prophylactic penicillin and salicylate therapy. Throughout the hospital course the white-cell count ranged between normal and 13,900; the hemoglobin was 13.5 gm. per 100 ml. The pericardial friction rub persisted, but it was somewhat diminished in intensity and associated with pain in the anterior portion of the chest. Other physical findings persisted. X-ray films of the chest at the time of discharge demonstrated a slight increase in the size of the heart and a small collection of fluid in the right pleural space.

Final admission (seven days later). In the interval the dyspnea, orthopnea and edema increased. Five days before entry the pericardial friction rub became louder. One and a half days before admission the patient noted the onset of wheezing and a slight, inconstant nonradiating pain in the left fourth and fifth intercostal spaces at the midclavicular line. The pain was unassociated with respiratory movements. At the same time there was persistent aching and soreness of the shoulders and right wrist. During the night before admission there were six episodes of paroxysmal dyspnea.

Physical examination was about the same as during the previous admission. There were expiratory wheezes throughout the chest. The pericardial friction rub was coarse and leathery and heard over the entire precordium. The temperature was 100.4°F.

The urine gave a ++ test for albumin; the sediment contained 2 to 4 red cells per high-power field. Examination of the blood revealed a hemoglobin of 10.6 gm. per 100 ml. and a white-cell count of 12,700, with 83 per cent neutrophils. The serum nonprotein nitrogen was 52 mg., and the bilirubin 0.9 mg. per 100 ml. The serum electrolytes were normal. Three blood cultures showed no growth. An x-ray film of the chest demonstrated no changes in addition to those previously noted. An electrocardiogram revealed atrial fibrillation at a ventricular rate of about 120, a QRS interval of 0.08 second and a normal axis. The

ST segments were depressed, and the T waves were diphasic in Leads 1, 2, 3, aVF, V_5 and V_6; the R waves were low in Leads V_1 through V_4 and tall in Leads V_5 and V_6.

The patient's condition deteriorated rapidly and, in spite of oxygen, aminophylline, increased digitalis, ACTH, Meticorten, diuretics, Southey tubes and tourniquets the dyspnea worsened, and he died on the

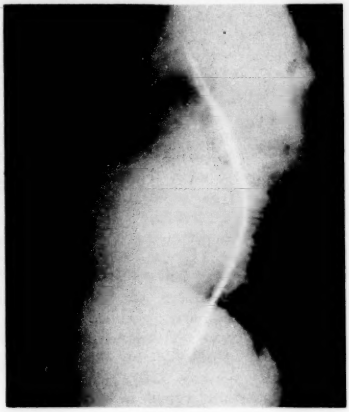

FIGURE 4.

second hospital day in intractable pulmonary edema. Terminally, the temperature rose to 105.6°F., and there were focal twitchings that progressed to generalized seizures. An x-ray film of the chest showed marked pulmonary edema (Fig. 4).

DIFFERENTIAL DIAGNOSIS

DR. EDWARD F. BLAND*: It is quite clear that this relatively young man had chronic rheumatic heart disease and unfortunately had most of the complications that can occur to such patients. At the age of twenty he was found to have a heart murmur. Presumably, that was at the beginning of World War II or thereabouts; anyway, he was turned down by the military services. He had been in good health without a previous history suggestive of rheumatic fever. Six years later he was admitted to the hospital with a very serious illness, which presented itself as acute meningitis. Upon further study, it evolved that this was an unusual presenting sign of bacterial endocarditis, for which the evidence seemed quite clear; the blood cultures were positive; he had a small embolus, and he responded to protracted antibiotic therapy. Thereafter, he was relatively well for ten years.

Bacterial endocarditis is a serious complication of rheumatic heart disease; it interferes with the well-being of patients in a variety of ways. It is still fatal to a certain number. In a few cases it deforms the valves so drastically in the healing process that the patients are never well thereafter. It is especially serious when it involves the aortic valve extensively. In some patients it appears to reactivate the rheumatic process in the myocardium. I suspect that that is what occurred in the case under discussion.

Four years later, when he was thirty-two, he noticed shortness of breath. A year or two later he began to wheeze on effort and occasionally raised blood-tinged sputum. In other words, the rheumatic heart disease had slowly progressed. He had signs of pulmonary stasis, pulmonary hypertension and occasionally hemoptysis. On one or two occasions he actually had acute pulmonary edema. These findings all point to a higher degree of mitral stenosis than we have a right to expect simply from the description of the murmurs and the other physical signs. At that time the electrocardiogram was not very revealing.

Four years before he died he began to have more persistent trouble although he still had a normal sinus rhythm. There was x-ray evidence of increasing size of the heart, of pulmonary congestion and of pulmonary edema. I wonder if Dr. Carrigan will show us the original films made at the time of the bacterial endocarditis and contrast them with those made six years later.

DR. FRANCIS P. CARRIGAN†: The posteroanterior films of the chest (Fig. 1) taken at the time of the first admission show that the heart is of relatively normal size, is in the mid-line and has no unusual changes in its silhouette except possibly some fullness in the left upper border in the region of the main pulmonary artery. We have seen this type of shadow when the heart was normal, but in view of the later developments, I shall mention it. The right and left borders of the heart are not displaced. There is a left aortic arch. The vascular channels in the mediastinal and paramediastinal areas are within normal limits. The heart is well compensated at this time. The lateral films show a relatively normal heart with questionable enlargement of the pulmonary artery.

Six years later the posteroanterior films show quite a change in the size and configuration of the heart (Fig. 2). The heart has enlarged, and there is evidence of early failure, with pulmonary edema. The projection does not bring it out too well, but I believe I can see the enlarged left atrium sweeping around to the right of the mid-line. There is marked engorgement of the hilar vessels. There is pulmonary edema, with indications of beginning failure. The film taken in a minimal degree of right obliquity demonstrates the sweep of the enlarged left atrium displacing the lower esophagus at this point. The atrium apparently is markedly enlarged on the left side. I also believe

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that there is some enlargement of the right ventricle, probably of the outflow tract.

DR. BLAND: I am not sure whether or not the possibility of surgical help was seriously considered four years before the final admission. The apical diastolic murmur, however, was not suggestive of a high degree of mitral stenosis, but in the presence of active rheumatic disease we are often misled in interpreting murmurs. From there on, the patient went progressively downhill. He had a slight aortic diastolic murmur, which I suspect meant aortic regurgitation rather than functional pulmonary regurgitation. By the time of the second admission he was in frank congestive heart failure, with an enlarged liver, swollen veins and massive edema. I say massive, because Southey tubes were used; they ordinarily are not used unless the edema is intractable and of considerable degree. Atrial fibrillation appeared — another stage in the progressive course of the disease. Furthermore, he almost surely began to have pulmonary emboli and infarcts. I say "almost surely," because we know that when Dr. Castleman studies patients at this age in congestive heart failure with chronic rheumatic heart disease he finds that 60 to 70 per cent have had pulmonary infarcts, which very often were not suspected clinically. In the patient under discussion I think the evidence was fairly convincing, at least to the physician in charge of him, for there was ligation of the femoral veins. He was later put on anticoagulant therapy. Both these measures were directed against the possibility of thrombophlebitis and recurrent pulmonary emboli.

Now perhaps I might see the films taken during the final admission.

DR. CARRIGAN: The posteroanterior film of the chest shows a massive heart shadow, with the right and left borders displaced and some degree of triangulation (Fig. 3). The left atrium is a massive structure extending well to the right, elevating the left bronchus and spreading the carina. The left cardiac border approaches the lateral wall of the chest; the lung fields, considering the degree of the enlargement of the heart, are relatively clear. There is some question about the status of the left side of the chest, where the protocol indicates that there is a triangular shadow suggestive of infarction; the left costophrenic angle is obliterated to some degree, but it is difficult to make a definitive diagnosis on these films. I think it would be more susceptible to diagnosis at fluoroscopy. A month later the film demonstrates the same picture, with relatively clear lung fields. There is no free fluid on the right; there is questionable exudate in the base of the pleural cavity on the left side. In the right lateral film the heart shadow practically fills the anteroposterior diameter of the chest; the right ventricle appears to be massive, and the opposite oblique films show what appears to be an enlarged left ventricle.

DR. BLAND: Under these circumstances, especially in younger people, we ask our x-ray colleagues if they can help us decide whether the heart is large and flabby or whether there is a large pericardial effusion. Our experience is that we are not able to distinguish between those in the films. Have you any thoughts about this particular case?

DR. CARRIGAN: I think that fluoroscopy would help determine the presence of a pericardial exudate. The degree of amplitude of the contractions of the different segments of the heart is helpful. I should depend upon that together with the appearance on the films. I think that there is some pericardial exudate in this case.

The film taken during the final admission reveals massive enlargement of the heart, with indications of some failure and pulmonary edema. The lower left portion of the chest is obscured somewhat, but there is not very much free exudate present. The configuration is still somewhat triangular.

DR. BLAND: The physicians in charge were obviously not inclined to attribute this configuration to a large pericardial effusion because no mention was made of exploration with a needle. I suppose they were influenced by our general experience that although pericarditis is common in patients with rheumatic fever, large effusions, although they may occur, are relatively infrequent. I have no explanation for that. I am still uncertain about whether the x-ray silhouette represented a large, weakened heart similar to the picture seen in childhood or a considerable effusion. In any event new symptoms appeared. The patient had abdominal distress, which was highly suggestive of emboli, possibly to the kidneys or the spleen. He was a likely candidate for systemic as well as pulmonary emboli.

I am intrigued particularly by the course during the last few weeks of the illness when arthralgia developed. There was more pain in the chest anteriorly, not particularly the type associated with pulmonary infarction, which he had had previously. A widely heard, loud, to-and-fro, pericardial friction rub developed, and the electrocardiogram showed atrial fibrillation. He was treated vigorously with salicylates so that those in charge had rheumatic activity in mind. Finally, he improved a little and was sent home but in poor condition. When he returned a week later, much worse, with urinary signs, I suspect that he probably had congestion rather than anything else. In desperation at the very end he was given steroid therapy, probably on the supposition that he had active rheumatic fever. I should like to raise the possibility that he had rheumatic pneumonitis or pleuritis as well as rheumatic pericarditis.

I am forced in conclusion to believe that the entire course was influenced and perhaps determined by the rheumatic-fever activity. The patient had many of the subtle manifestations that go with this at this age and also in the childhood group. I shall

be particularly interested to learn whether or not Dr. Castleman found a large pericardial effusion. My suspicion is that perhaps it was not of major proportions. We know that an active pericardial inflammation was present. I should be interested to hear what he has to say about the aortic valve. I think he will tell us that it was only slightly involved. The degree of mitral stenosis is of interest. If I rely on the physical signs, on the basis of the murmurs alone I might be confused, but if I put more weight on the evolution of the disease with the high degree of pulmonary hypertension, I must assume that there was a considerable degree of mitral disease. The state of the tricuspid valve will be of academic interest because, as one sees from the films, in spite of the large heart and massive edema of the liver and veins, the lungs remained fairly clear until the very end; therefore, there had possibly been functional stretching or regurgitation through the tricuspid valve.

I have left out of consideration the possibility that at the end the patient had bacterial endocarditis. I do not think so, for a variety of reasons. The course was characteristic of progression of rheumatic heart disease. This degree of heart failure with bacterial endocarditis would be unusual. The kidneys remained good functionally until the end. The fact that the blood cultures were negative does not seriously influence me against it. I suspect that the whole trouble from beginning to end was rheumatic fever.

DR. BENJAMIN CASTLEMAN: Dr. Dack, should you like to question Dr. Bland on any of his statements?

DR. SIMON DACK*: I think he has given such a clear analysis that I cannot disagree with any of his interpretations. I am intrigued with the long-standing friction rub; I should like Dr. Bland to tell us what the possible causes of a pericarditis are in a man who has rheumatic heart disease if there is not a great deal of fluid. Why should he have a friction rub for such a long time unless he had a large effusion?

DR. BLAND: That is a good point. I should have expected it to wax and wane and for him to be sicker with more fever, but he was not. I am a little bothered by the duration of the friction rub, too. In rheumatic fever it may last a month or two, but usually not as long as it did in the patient under discussion. I am certain this case will present some bizarre features — otherwise, it would not have been presented on this program.

DR. DACK: That is why I am asking this.

DR. BLAND: A malignant process of the mediastinum extending into the pericardium will give rise to long-standing pericardial effusion, but the effusion usually does not persist for four months without the development of cardiac tamponade. We know that this man had rheumatic heart disease; I think the effusion was an unusual variant of rheumatic pericarditis.

DR. DACK: Have you ever heard a friction rub in a case with recurrent pulmonary infarction that sounded like a pericardial rub?

DR. BLAND: Yes; I have, but not quite as widespread as this. I assume that this rub was heard over both sides of the chest. I have heard friction rubs along one border of the heart that were to and fro synchronously with the heart beat, but on occasion I was quite confident that they were secondary to an adjacent pulmonary infarction rather than to pericarditis.

DR. CASTLEMAN: What would your diagnosis be, Dr. Dack?

DR. DACK: From the x-ray films and from the long-standing rub I believe that this patient had a pericarditis with effusion. Whether it was due to rheumatic fever or to some other condition I do not know. When there is a prolonged friction rub, it suggests other causes for pericarditis than rheumatic fever, such as tuberculosis and obscure viral infection. I have seen it in lupus erythematosus and in other forms of systemic arterial disease.

DR. CASTLEMAN: Do you have any other suggestion about the underlying diagnosis, or do you agree with Dr. Bland?

DR. DACK: I should agree with him that the pathologist probably found that the mitral lesion was more severe than was suggested by the physical findings. I believe that there was a very tight mitral stenosis even though the murmurs were not typical. Both atria probably contained thrombi that were responsible for the pulmonary emboli as well as for the systemic arterial emboli.

DR. CASTLEMAN: Dr. Bland, how are you accounting for the harsh systolic murmur that was heard ten years before death and continued to grow stronger? By a mitral stenosis?

DR. BLAND: I am not fully accounting for that. I am always uncomfortable when Dr. Castleman asks such a pointed question: perhaps, when the patient was nineteen years old or thereabouts, he had minimal rheumatic scarring of the mitral valve, predominantly with regurgitation. Everything in the later clinical course pointed to mitral stenosis. I think we are less often fooled when we rely upon that rather than upon the waxing and waning of a particular diastolic murmur. Once in about a hundred times mitral stenosis is present without a diastolic murmur, especially in patients with large hearts. I cannot change my mind in spite of your question.

DR. CASTLEMAN: When this case was presented to Dr. Paul D. White at Graduate Student Rounds, he concurred that active rheumatic fever was most

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likely. He believed that the valve lesions were slight mitral stenosis with mitral regurgitation and slight aortic regurgitation.

DR. BLAND: My only objection to that interpretation is that five years before this patient died, when he still had regular sinus rhythm, he apparently had pulmonary hypertension. Hemorrhage and pulmonary edema mean pulmonary hypertension of considerable degree, and both are against predominant mitral regurgitation.

DR. DACK: I should go along with that; even though the patient may have had slight mitral insufficiency, I should expect to find a marked degree of mitral stenosis.

DR. CASTLEMAN: Does anyone in the audience wish to present other diagnoses?

A PHYSICIAN: In the presence of severe failure is an electrocardiographic report of a ventricular rate of 70 significant?

DR. BLAND: Should you like to see the electrocardiograms? There are puzzling findings in them. I hoped that I should not have to show them. Dr. Castleman warned that they would probably confuse us. In the first one taken when the patient had a bacterial endocarditis, it will be seen that the P waves are somewhat broad; the PR interval is normal. There is no clearly abnormal ventricular preponderance, but if anything a little more to the pattern of left rather than of right ventricular hypertrophy. A later tracing, taken toward the end of life, when the patient was seriously ill and had a large heart, shows a lowering of voltage, which is more consistent with pericardial effusion than with simple dilatation. There is no shift of the axis to the right, which we sometimes see with acute or subacute cardiac dilatation in rheumatic activity. The question I raise is why the rate was so well controlled in spite of cardiac failure and I might add in spite of infection, if that was present, and, indeed, with possible multiple recurring pulmonary emboli with infarction. Those are circumstances under which it is usually difficult to control the ventricular rate, but it is not always so, especially if the patient can take a great deal of digitalis. I cannot use that either for or against the diagnosis. If anything, it is against all three possibilities — namely, rheumatic activity, recurrent pulmonary emboli and other types of infection.

DR. DACK: From the record one would expect, in addition to mitral stenosis, hypertrophy of the left ventricle that was due either to mitral insufficiency or to aortic insufficiency.

CLINICAL DIAGNOSES

Rheumatic heart disease, with active rheumatic fever, mitral stenosis and regurgitation.
Aortic stenosis and regurgitation.
? Pericardial effusion.
Heart failure.
Old pulmonary infarctions, left.

DR. EDWARD F. BLAND'S DIAGNOSES

Active rheumatic fever.
Rheumatic pericarditis.
? Rheumatic pneumonitis.
Healed bacterial endocarditis.
Mitral stenosis and regurgitation.
Slight aortic regurgitation.
Congestive heart failure.

ANATOMICAL DIAGNOSES

Healed bacterial endocarditis, with mycotic aneurysm of mitral valve with perforation.
Subacute pericarditis, with massive hemorrhagic effusions.
Rheumatic valvulitis, mitral and ?aortic, healed, minimal.
Pulmonary edema and congestion, severe.
Cardiac hypertrophy.

PATHOLOGICAL DISCUSSION

DR. CASTLEMAN: At post-mortem examination we found that Dr. Dack was correct, that the large heart shadow was caused almost entirely, although not completely, by a huge pericardial effusion composed of 2 liters of hemorrhagic fluid and fibrin — in other words, a shaggy inflammatory reaction of the pericardium — not only in the parietal but also in the visceral layer of the heart (Fig. 5). It will be recalled that the hemoglobin went down from 11.3 to 10.6 gm. per 100 ml. so that there must have been a great deal of bleeding into the pericardial cavity. Whether this was due in part to the Dicumarol, I do not know. The amount of Dicumarol given was not great, but it may have been a factor in the production of the hemorrhagic inflammatory reaction. The heart muscle itself was entirely normal throughout. We made many sections and could find no evidence of rheumatic activity. The pericardial exudate was made up of monocytes, many foam cells, cholesterol crystals and foreign-body giant cells. It must have been present for a long time, probably for about four months. The patient began to complain of sudden failure two months before admission to the hospital.

Bulging into the mitral valve was a mass that not only caused stenosis of the mitral orifice but almost certainly prevented the valve from closing entirely, and therefore there must have been a large amount of regurgitation. When the valve was cut, the mass proved to be a pouch attached to the aortic leaflet of the mitral valve (Fig. 6). It measured 2.0 by 1.3 cm. at its base and protruded above the surface of the valve into the lumen for about 2.5 cm. The core of this pouch, or what was really an aneurysm, was

hollow, open at its base and perforated at its tip, the perforation measuring 2 by 1 cm. The other side of this orifice opened into the left ventricle, thus allowing for added regurgitation when the mitral valve was closed (Fig. 7). The chordae tendineae were only slightly thickened — evidence of only minimal rheumatic involvement. Extending from the aortic

FIGURE 5

leaflet of the mitral valve on the ventricular aspect up into the commissure of the aortic valve was a healed fibrotic and calcified process (Fig. 7). This may have represented old rheumatic involvement of the aortic valve, with fusion, or may merely have been an extension of the mitral process — namely, a healed bacterial endocarditis.

In putting all this together, I believe that the patient had a mild degree of rheumatic involvement of the mitral and perhaps of the aortic valve and that on the first admission, when he was twenty-six years of age, he had, as Dr. Bland suggested, subacute bacterial endocarditis, which healed. In the healing process — as Dr. Bland emphasized, and I had hoped that he would continue in that same vein — the valve was affected and formed a mycotic aneurysm, which this pouch was. Apparently, the patient got along fairly well until four or five years later, when he began to have heart failure. The question in my mind, and one that I have not completely settled, is, When did this mycotic aneurysm rupture? Microscopical examination of the tear shows no evidence of any inflammation. The pouch around the tear is perfectly bland — just fibrous tissue. It is conceivable that it ruptured during the last admission and that that is the reason why there was a great deal more pulmonary edema. The tear was rounded and not very sharp, so that it may have occurred four or five years before, permitting mitral regurgitation. I cannot answer the question about when it occurred, but I am certain that the pouch was a healed mycotic aneurysm resulting from the subacute bacterial endocarditis ten years before he died.

DR. BLAND: I, too, am wondering when the fenestration of the aortic cusp of the mitral valve occurred. We know from our surgical colleagues that that is the cusp that they have to avoid. If they injure, cut or deform the aortic cusp of the mitral valve, the patient's condition usually deteriorates rapidly. It is difficult to believe that the ruptured fenestration existed for ten years, possibly for four years, when he began to fail.

DR. CASTLEMAN: The lungs together weighed over 2000 gm., and were markedly edematous and congested. Microscopically, there were many heart-

FIGURE 6.

failure cells; there was no evidence of pulmonary infarction. Returning to the pericarditis; I do not know what the etiology of it was; I suppose it was rheumatic. We did culture a hemolytic streptococcus from it at autopsy, but the clinical picture of four months' duration did not fit a hemolytic streptococcal pericarditis. It is possible that there was a rheumatic pericarditis or a nonspecific hemorrhagic pericarditis.

DR. BLAND: If we keep questioning Dr. Castleman long enough maybe we can make him weaken. We have seen the shaggy hemorrhagic type of peri-

carditis in rheumatic children who have not received anticoagulants. I should be disinclined to think that the very slight exposure to anticoagulants had much to do with it.

DR. DACK: I have seen 2 such cases, but in those cases the aneurysm of the aortic sinus ruptured into the right atrium instead of into the left, and the murmurs were more distinctive of a fistula. I think you are holding back on us: a to-and-fro murmur should have been described, and was not, in the case under discussion.

DR. CASTLEMAN: That is if you assume that the perforation had occurred four years before the final admission.

DR. DACK: Since you say the edges were smooth, I cannot imagine that it occurred only days before death. Since there was a sudden deterioration of the patient's cardiac condition four years before the final admission and since there was no serious damage to the mitral valve, I assume that at that time the aneurysm pouched into the orifice of the mitral valve and caused obstruction and insufficiency or probably even ruptured into the left atrium, to produce the pulmonary edema and congestion and hemoptysis.

DR. CASTLEMAN: That is why I asked about the harsh, systolic murmur; I wondered whether the rupture was the reason for the increase in the regurgitation.

DR. DACK: I think that would be it. However, as I stated before, when there is an actual perforation, one hears not only a systolic murmur but also a to-and-fro murmur just as in an arteriovenous aneurysm.

DR. CASTLEMAN: That was not present.

DR. BLAND: What about the tricuspid valve?

DR. CASTLEMAN: That was normal.

A PHYSICIAN: Did the coronary arteries show any change?

DR. CASTLEMAN: No.

DR. BLAND: In conclusion, Dr. Castleman, this represents the mitral counterpart of the entity that we are encountering only since the antibiotic era of patients who are rescued from bacterial endocarditis but are left with so much additional structural damage to their valves that their hearts never fully recover. This sequence, as you well know, we have

FIGURE 7.

repeatedly commented upon in those left with high degrees of aortic regurgitation, which is much less well tolerated than comparable regurgitation at the mitral orifice — hence, the probable explanation for this patient's relatively long survival after the serious disintegration of his mitral cusp. However, the explanation for the inflammatory pericarditis must rest on some other basis, presumably a "rheumatic" one.

In this connection it is worth while to record the unique case of Adam* concerning a young man, nineteen years of age, who attempted suicide and was shot through the anterior leaflet of the mitral valve; he survived with a high degree of pure mitral regurgitation for ten years and ultimately succumbed with chronic congestive heart failure.

*Adam, A. Ueber die traumatischen Veränderungen gesunder Klappen des Herzens. *Ztschr. f. Kreislaufforsch.* **19**:313-330, 1927.

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ADRENOCORTICAL HORMONES FOR RHEUMATIC FEVER

THE conscientious physician, anxious to provide the most effective remedies for his patient without doing him unnecessary harm, must certainly be perplexed when confronted with the question of administering adrenocortical hormones to patients with acute rheumatic fever. Do these hormones really have a favorable effect on the course of rheumatic fever beyond the façade of well-being engendered by their pharmacologic action? Do they actually prevent or favorably influence the incidence and extent of the cardiac lesions? Or are these hormones, as far as their true value is concerned, merely "expensive forms of aspirin," which, like many forms of luxuries, may bring with them more burdens than comfort? The recent literature in this field, far from clarifying the problem, seems to be constantly adding to the confusion.

Last year the early results of the first extensive and strictly controlled study on the use of ACTH, cortisone and aspirin in children with acute rheumatic fever were reported. That study,[1] which included about 500 patients, was carried out by a group of outstanding clinicians and scientists in this country, Canada and the United Kingdom. The conclusions drawn appeared to be unequivocal: after the first year of observation, there was no appreciable advantage of the hormones over aspirin by any of the criteria that were chosen. The conditions set forth in the study included a strictly random selection of cases and predetermined criteria for diagnosis, dosage regimens, duration of therapy and methods of observation and follow-up study, as well as careful analysis of the data collected.

Before these findings were reported there had been numerous reports of observations, most of them uncontrolled or inadequately controlled, that yielded varying results and led to widely divergent conclusions. Indeed, it was these conflicting reports, some of which were summarized by Massell[2] in his Medical Progress report in 1954, that had stimulated the cooperative study. That even the results of the latter study have not convinced some of the workers who had expressed enthusiasm for the hormone therapy on the basis of their own experiences is adequately demonstrated by a number of papers that have subsequently appeared; some of them have already received comment in these columns.[3] However, the results claimed by the proponents of large doses of hormones are not clearly better than those reported from the use of aspirin or of the lower doses of hormones employed in the co-operative study.

One of the dissenters, an outstanding worker who has had a long, continuous experience with rheumatic fever and its sequelae, recently summarized her observations.[4] She concluded that the course of carditis in patients receiving adequate hormone therapy be-

fore irreversible damage was sustained is considerably shortened and the extent of the residual cardiac damage is markedly limited as compared with patients not treated with hormones. These conclusions were based on the findings in one group of 55 patients treated with hormones and compared with another group of 100 so-called control patients "drawn arbitrarily for analysis from the active files of the cardiac clinic" and also with patients observed over the twenty-five-year period, 1930-1955. Analysis of the course of active rheumatic carditis in the patients receiving symptomatic therapy revealed no significant change during this period. The average duration of the carditis was less than a month in only 20 per cent, two to four months in 30 per cent and more than four months in 50 per cent. Residual cardiac damage was present in every patient. In patients receiving hormone therapy in moderately large doses beginning three to twenty-one days after onset of illness and continuing for an average period of seven days, the duration of active carditis was less than a month in 69 per cent, and less than two months in 31 per cent. In 84 per cent of the patients, whose attacks were initial, there was no overt evidence of residual damage.

Although these figures are admittedly impressive, they unfortunately fail to carry any conviction because no evidence is presented that the two groups of cases are actually comparable or that the hormone-treated cases are not, in fact, a distillate of favorable cases chosen for that therapy. The possibility that fundamental differences in the cases at the time of inclusion in the study, or other factors in their selection, management, study and analysis, were the major factors in the different effects observed is strongly suggested not only by the findings in the co-operative study referred to above but also by those of a study more recently reported from Philadelphia.[5]

In the latter study 100 cases were selected at random by cyclic rotation for treatment with either ACTH or cortisone or a plan of supportive and symptomatic therapy, including only modest doses of aspirin. This rotation, moreover, was carried out within each of three groups according to whether there was no carditis, an initial episode of carditis or recurrent carditis when the patients first came under observation. The hormone therapy was carried out with predetermined dosage regimens and beginning with fairly large doses, and was continued for three weeks or longer (mean of twenty-seven days). No significant differences in any of the cardiac findings were noted in the three treatment groups throughout the period of observation in the hospital.

The sharp contrast in the findings and conclusions in these two studies, as in those of similar studies referred to earlier, is so striking and so important that it cannot and should not be passed off lightly. The importance of determining the basis for the divergent results stems not only from the immediate and ultimate effects on the cardiac findings, which were the focus of the studies under discussion here, but also from the fact that serious complications may accompany the use of hormones. In the Philadelphia study a case of purulent meningitis was recognized four days after the hormone therapy was ended, and an extensive abscess occurred in another patient at the site of the hormone injection in spite of prophylactic antibiotics, and this required surgical drainage and resulted in prolonged morbidity. There were also 2 cases of pneumonitis associated with severe carditis, several minor viral infections, 13 cases of hypertension and an apparently excessive prevalence of edema and cardiac failures among the hormone-treated patients.

A paper presented at the recent national meeting of the American Federation for Clinical Research[6] is also of interest in view of the current increase in the use of prednisone as a supposedly more effective steroid than cortisone and one less prone to untoward effects. In an experimental attempt to prevent cardiac sequelae, 11 patients with acute rheumatic fever were treated with large doses of prednisone for forty to one hundred and seventy-one days. The treatment had to be discontinued because of the occurrence of severe osteoporosis and compression fractures of the vertebras in 3 of these patients after gradual, stepwise reduction of the dose. During the early post-treatment period there were marked and prolonged "rebound" effects in 9 patients. In addition, 5 patients experienced a peculiar syndrome characterized by intense pruritus and painful erythema-nodosum-like lesions of the skin, and extensive panniculitis with fat necrosis and fibrinoid occlusions of venules developed in 2. Two also manifested congestive heart failure, and 1 of them died. However, it was stated that none of the patients had typical evidence of recrudescences of rheumatic fever or carditis. The findings were interpreted as indicating that the steroid therapy had introduced a new pathologic process probably involving vascular integrity. The authors stressed the need for caution before advocating the widespread use of large doses of steroids in the treatment of acute rheumatic fever. This caution is also dictated by the recent report of fatal varicella in children during treatment with cortisone.[7]

If one is to expose patients with rheumatic fever to such hazards, it is essential to make every effort to determine whether greater benefits to the patients are to be expected to compensate for these risks. It would be helpful to the perplexed physician in search of rational therapy if workers presenting data and conclusions that are in conflict with similar observations and deductions of others attempted to determine the sources of the discrepancies. It is certainly to be hoped that a more convincing evaluation of the proper place, if any, of the adrenal hormones in the management of rheumatic fever will thus be

established. The same thing may be said of rheumatoid arthritis in both adults and children, for when parallel cases are treated with aspirin and hormones[8] the effect on this disease may also be indistinguishable.

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HEALTH FOR THE AMERICAN PEOPLE

On November 21, 1955, a symposium — not to be confused with the more literal drinking together suggested by the term — was held at the Hotel Statler in Boston, to celebrate the centenary of the founding of the Massachusetts Memorial Hospitals. Despite the ancient connotation the conversations were far from arid; they were divided into three panels devoted to a discussion of the health of the American people. The discussions and their summary were published in book form in June by Little, Brown and Company and are of significant value to public and profession alike.

Health is always a laudable objective and as many as possible of the obstacles in the way of its attainment should be removed; a big problem today in view of rising costs in general and the unprecedented extension of scientific knowledge in particular is the financing of medical research and education and, for the patient, of a quality of medical care that takes advantage of the expanded facilities. No symposium could hope to solve this problem, but a careful examination of the subject was effected.

The three panels were on organization of health services, conducted by Dr. Dean A. Clark, general director of the Massachusetts General Hospital and professor of preventive medicine at the Harvard Medical School; paying for health services, led by Dr. Chester S. Keefer, director, Boston University School of Medicine and physician-in-chief of the Massachusetts Memorial Hospitals; and community action for health, moderated by Dr. Robert W. Wilkins, professor of medicine at Boston University School of Medicine and associate physician-in-chief of the Massachusetts Memorial Hospitals. The final general discussion was directed by Judge Bailey Aldrich, of the Federal District Court of Boston. The list of 17 participants represented a unique Who's Who of American men of medicine, science, industry and philosophy.

Considerable argument, as was to be expected, revolved around the place of the general practitioner in modern American medicine, with the discussants unanimous in their desire to fit him in somewhere near the center of the picture. The statement was evoked, and was unchallenged, that half the health care of the nation is still given by family physicians, of whom a considerable number are sufficiently able to be classed as superior. One of the family physician's great handicaps is his lack of special training, which cannot come in the medical-school curriculum, restricted as the curriculum must be to the basic requirements of medicine, and is still far from adequately offered as a division of hospital training. The same handicap, of course, must be met by the specialist.

As a corollary to the difficulty encountered by the general practitioner in search of a broad training is the insecurity of the specialist when called upon to face a situation outside his restricted purview. His perfectionism in his field — his need for all the special properties with which he has surrounded himself — add unnecessarily to the costs of specialized care.

Group offerings along prepayment lines, sometimes confused with "health insurance," are accepted as effective devices for the equitable distribution of medical care for today and still more for tomorrow; a central figure in these plans is the general practitioner, family doctor, personal physician or "generalist" — a term as baffling on the one hand as "specialist" is on the other. The general physician (o.t.)* not only refuses to become obsolete but is benefiting from a greater build-up than ever before, though not in the old sense of the general practitioner who sees all and knows all — or at least does all.

The keynote is for specialists and generalists to work together in that mutual regard that has repeatedly been shown to be possible. One of the hazards in these relations is that of permitting the general physician in his broad field to be patronized by the specialist from his narrow chamber.

In respect to the device strangely known as health insurance — possibly because it cannot insure health, or even insure against it, for all it can do is to insure against the cost of sickness (by the same token, life insurance should be called death insurance) — a separation must be made, according to the experts, between insurable and uninsurable types of service. For increased acceptability not only must more persons be covered by broader benefits but the insurance of older persons must be considered. And if words are to be used as definitively as possible the question must come up regarding preventive medicine: what

*(our terminology)

it is, and what it prevents, outside the field of infectious disease. Still other elucidations are necessary, according to a panelist who points out that organized medicine identifies the voluntary way as the American way, then insists that this must be the way that the profession of medicine itself favors.

Continued education of both the public and the medical profession in the methods of delivering and paying for medical service is necessary, and sober recognition of the fact that labor groups, although at present uninformed regarding their real need, want a comprehensive form of prepayment. And the eventual pattern or patterns of financing and administering medical care in this country, according to an observer from abroad, will be established by the leaders of organized labor. If and when this comes about it may be presumed that labor will work even more co-operatively with management, benefiting thereby from the rich and varied administrative experience that is available.

DRAGON'S TEETH?

Fewer cats than men have been killed by curiosity. Man's compulsion to tamper with his environment is not shared by the self-centered feline. Bold, imaginative *homo sapiens* hurls himself blindfolded into the Unknown, hoping — when he gives it a thought — to land on his feet — a skill at which the cat is more adept.

The latest and boldest leap started within the life span of an elder citizen, some seventy years ago, when Sir William Crookes released electrons in a cathode tube. In 1895 Wilhelm Roentgen discovered the x-ray and its capacity for passing through human tissue. Three years later the Curies came upon radium. Fourteen years ago the first self-sustaining nuclear chain reaction occurred at the University of Chicago. In 1945 an atomic bomb bloomed in New Mexico. And tomorrow?

Artificially produced radiation is a new and strange factor in the environment. It has constantly increased since its initial medical application through radiology. But until the development of nuclear weapons the human body was subjected to this source of energy under controlled conditions. Those working with radioactive materials, high-voltage electron accelerators, x-ray equipment and fluoroscopy did so at their own risk and of their free will.

The explosion of nuclear devices has released vast amounts of radioactivity into the environment, to be diffused widely by air and ocean currents. The Atomic Energy Commission insists that weapons tests have elevated the level of radiation to a point far below what it considers harmful. The tests continue even as studies attempt to determine if their by-products may be injurious to life and health.

Efforts are also under way to leash the atom for the benefit of man. Its most potent economic application is likely to be to the generation of electric power. The nation's utilities are planning several developmental reactors in co-operation with the Commission, one of which would be built by the Yankee Atomic Electric Company at Rowe, and a smaller one by the city-owned utility in Holyoke, both in western Massachusetts. Of these, Yankee's reactor alone will contain enough fissionable matter to contaminate critically a large part of eastern New England in the event of a "runaway" dispersion of fuel. The possibility that a reactor will circumvent its intricate series of controls and shields is extremely remote. Still, it is man-made; it presents a hazard to society.

Living is risky at best. Houses have stairs, and streets have automobiles. But the risk incurred when one descends to breakfast or drives to work is calculated; the stakes are known, the chances are weighed, and certain precautions are taken. Likewise, responsible operators of radiologic equipment, atom smashers and nuclear reactors, and handlers of radioisotopes and fissionable materials have the benefit of protection against obviously excessive radiation. So do patients receiving x-ray, radium, neutron-beam and isotope therapy.

The uses of the atom in the production of power, in medical diagnosis and therapy, in agriculture and in industry suggest a bright new world. It is not in the nature of man to measure his dreams in terms of risk. But intelligent progress in this field demands a conservative look at the hazard. And this raises a disturbing question, May not radiation be excessive without being obviously so?

Steadily greater numbers of the world's population are going to be in close proximity to fissionable material — its mining, extraction, processing, transport, application, reprocessing and disposal. A new atomic industry is developing. Each blessing involves a hazard; each risk demands a safeguard.

The health standards by which valid protections are measured must not be established at an arbitrary level somewhere below the point at which radiation produces an observably harmful effect. To do this would be equivalent to contending that a man cannot drown in water that comes only to his chin.

A great deal more must be known about the not-so-demonstrable effects of radiation for the sake of mankind and its future health — for the sake of generations to come. As things are, the atomic ball carrier is running well ahead of his interference: he is not going to stop in his tracks and wait for it to catch up.

A month ago the National Academy of Sciences made public a sobering report on radiation hazards. Its committee on genetics, headed by Dr. Warren Weaver, of the Rockefeller Foundation, was alarmed by the rate at which x-rays are consuming tolerance and urged the medical and dental professions to exer-

cise greater caution in their use. It advised a national system of personal radiation records and warned that total exposure from controllable sources should be held to 10 r during the first thirty years of life.

The entire report merits careful study by all concerned with the control and use of radiation, and it is hoped that it will promote franker and more extensive discussion of the hazards involved. The unspanned gaps in man's knowledge make it difficult to conceive of a precautionary measure so extreme as to be considered overconservative.

EPIDEMIOLOGY OF ACCIDENTS IN THE HOME

Do-it-yourself activities about the home have been given a relatively clean bill of health by the sedulous statisticians of the Metropolitan Life Insurance Company, according to a recent release from the information service of that organization. This does not alter the fact that home accidents kill about twice as many men as women at the main working ages; it means only that a bare 6 per cent of the company's male industrial policyholders from fifteen to sixty-four years of age who died in home accidents in recent years did so as a result of repair, maintenance or improvement work.

The lethal factors involved were falls, fires, firearm accidents and gas poisoning, all of which took the lives of men rather than women. Falls, however, were also prominent among the fatal do-it-yourself accidents; they included falls from ladders, roofs or scaffolds while the victims were painting, shingling or otherwise repairing roofs, or while working on television aerials. Deaths due to electric current, as previously stated,* are relatively uncommon and are practically limited to males. They largely result when men and boys come in contact with high-tension lines during the installation of television aerials or on exposure to ordinary current while working indoors.

The 1956 figures on snow removal as a do-it-yourself activity are not yet available.

*Editorial. Current statistics. *New Eng. J. Med.* **243**:662, 1955.

Astringent Lotion for Ulcers.—*A lotion consisting of half a drachm of the tincture of catechu, to a pint of the decoction of oak bark, is a favorite one at the Aldersgate street Dispensary, as an application to foul and indolent ulcers on the leg. . .* Med. Times

Boston M. & S. J. *July 10, 1856*

MASSACHUSETTS MEDICAL SOCIETY

COMMITTEE ON INDUSTRIAL HEALTH*

Carbon Tetrachloride Hazards

Many persons are unaware that the mere use of carbon tetrachloride as a cleaner for removing spots from garments can prove extremely dangerous to their health. The inhalation of fumes from this chemical — particularly when it occurs in a closed room — can even result in death. This is especially true when it is used by the householder before, during or after the ingestion of alcohol (liquors, beer or wines). Severe and often irreparable kidney damage and even death can follow the inhalation of minute amounts of this chemical by those who term themselves "light drinkers." Furthermore, since this is often a toxic cause unsuspected by either the patient or the physician, such a condition may well be wrongly diagnosed and treated, and this in itself adds to the extremely harmful effects.

The general public does not yet seem to realize that this clear, colorless, noninflammable liquid, whether purchased under its chemical name or under well known brand names for use as a cleaning fluid, represents a high potential of poison to the brain, the heart, the liver and the kidneys. So dangerous is this chemical that industrial firms whose workers have handled it have had to devise elaborate safeguards for them, and have substituted other chemicals wherever possible. Carbon tetrachloride is still in wide use, however, in dry cleaning, as a grease remover, for cleaning multigraph type and in the preparation of fire extinguishers under the name of Pyrene.

Carbon tetrachloride is in truth a narcotic, which was used as a general anesthetic until discontinued almost a century ago for that purpose because it was deemed too poisonous. Chloroform, a chemical with a similar structure, was found to be far less hazardous, and its use as an anesthetic has persisted to this day. Chloroform is as good a solvent as carbon tetrachloride for fats and related substances, but the ordinary physician would not think of allowing a person to keep a bottle of chloroform in his medicine cabinet or among the cleansing aids in the home. People themselves would be alarmed if they saw a bottle around the house labeled "chloroform." Such a reaction is universal, but, actually, a bottle of chloroform would be safer to have around the home than a bottle of carbon tetrachloride. Nevertheless, carbon

*George F. Wilkins, M.D., *Chairman*; Henry C. Marble, M.D.; Karl T. Benedict, M.D.; Harriet L. Hardy, M.D.; George E. Morris, M.D.; Albert O. Seeler, M.D.; and Jermyn F. McCahan, M.D.

tetrachloride is still widely merchandised as a solvent cleaner under various trade names, and as such is readily available to every householder. Indeed, it is at present in unrestricted use in many offices and plants.

Trichlorethylene

On the other hand trichlorethylene, a colorless, noninflammable liquid solvent cleaner, though perhaps not as well known as carbon tetrachloride, is immeasurably safer for the householder to use for hand spotting and cleaning of clothes and furs. In its use there is a wider safety margin than with carbon tetrachloride or chloroform, for it is far less toxic to the liver, kidney and brain.

Trichlorethylene, like carbon tetrachloride, can also be used for the degreasing of metals and the cleaning of multigraph type. Because it is so similar to carbon tetrachloride in its solvent properties, it has largely been substituted for the latter in commercial use, and accidents involving trichlorethylene most generally occur when workers become overwhelmed by massive exposure.

George E. Morris, M.D.

WARNING REGARDING MEDICAL PRACTICE

No Massachusetts physician may legally practice medicine until he has presented his certificate of registration to the clerk of the city or town where he has, or intends to have, an office or place of business (*General Laws,* Chapter 112, Section 8).

The penalty for violation of this section is a fine of $100 to $500. The consequences might be even more serious if the courts should apply the principle used in automobile-accident cases, in which the operator of an unregistered motor vehicle is held liable *even though not at fault.*

Robert W. Buck, M.D.
Secretary

DEATHS

Farley — William C. Farley, M.D., of Methuen, died on June 14. He was in his eighty-sixth year.

Dr. Farley received his degree from Hahnemann Medical College in 1894.

He is survived by a foster son.

Magill — Herbert K. Magill, M.D., of Brookline, died on May 14. He was in his forty-sixth year.

Dr. Magill received his degree from the University of Colorado School of Medicine in 1937. He was a fellow of the American College of Surgeons and a member of the American Academy of Orthopedic Surgeons, Boston Orthopedic Club and Massachusetts Society for Examining Physicians.

He is survived by his widow and a daughter.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH

COMMUNICABLE DISEASES IN MASSACHUSETTS FOR MAY, 1956

RÉSUMÉ

Disease	May 1956	May 1955	Seven-Year Median
Chancroid	3	2	3
Chicken pox	2231	2168	1865
Brucellosis	1	1	1
Diphtheria	3	2	7
Dog bite	1863	1707	1484
Dysentery, bacillary	0	23	6
Encephalitis, infectious	1	6	3
German measles	1392	642	1045
Gonorrhea	145	150	169
Granuloma inguinale	0	0	0
Hepatitis, infectious	30	86	25
Lymphogranuloma venereum	3	0	0
Malaria	0	0	1
Measles	438	4490	2385
Meningitis, meningococcal	6	4	7
Meningitis, Pfeiffer bacillus	3	5	5
Meningitis, pneumococcal	2	2	2
Meningitis, staphylococcal	1	0	0
Meningitis, streptococcal	0	0	0
Meningitis, undetermined	4	7	7
Mumps	534	1224	1224
Poliomyelitis	3	3	4
Salmonellosis	42	24	12
Scarlet fever	613	1469	519
Syphilis	250	142	148
Trichinosis	1	0	1
Tuberculosis, pulmonary	168	184	186
Tuberculosis, other forms	15	12	14
Typhoid fever	4	2	2
Whooping cough	73	127	147

Comment

Diseases below the seven-year median were diphtheria, bacillary dysentery, measles, mumps and whooping cough.

For the first time since 1952 no cases of bacillary dysentery were reported during the month of May.

Measles was at the lowest level for this month in the history of the State.

Mumps was at the lowest level for the month of May since 1929.

During May whooping cough was at the lowest level for this month in the State's history.

Diseases above the seven-year median were chicken pox, German measles, infectious hepatitis, salmonellosis and scarlet fever.

Although above the seven-year median, infectious hepatitis was at the lowest level for May since 1952.

Geographic Distribution of Certain Diseases

The following diseases were reported from the communities named:

Brucellosis: Easton, 1.

Diphtheria: Boston, 1; Cambridge, 1; Swampscott, 1; total, 3.

Dysentery, amebic: Pittsfield, 1; Somerville, 1; total, 2.

Encephalitis, infectious: Worcester, 1.

Hepatitis, infectious: Arlington, 1; Belchertown, 1; Boston, 2; Bourne, 1; Cambridge, 1; Chelmsford, 1; Chelsea Naval Hospital, 2; Fall River, 2; Holyoke, 1; Lowell, 1; Medford, 1; Norwood, 2; Quincy, 2; Seekonk, 1; Somerville, 2; Taunton, 3; Waltham, 1; West Springfield, 1; Wilbraham, 1; Worcester, 3; total, 30.

Meningitis, meningococcal: Boston, 2; Concord, 1; Gardner, 1; Milton, 1; Somerville, 1; total, 6.

Meningitis, Pfeiffer bacillus: Billerica, 1; Concord, 1; Plymouth, 1; total, 3.

Meningitis, pneumococcal: Belmont, 1; Rutland, 1; total, 2.

Meningitis, staphylococcal: Peabody, 1.

Meningitis, undetermined: Boston, 1; Hanover, 1; Plymouth, 1; Shrewsbury, 1; total, 4.

Poliomyelitis: Pittsfield, 1; Wakefield, 1; Yarmouth, 1; total, 3.

Salmonellosis: Arlington, 3; Ashland, 4; Boston, 4; Cambridge, 2; Chelsea, 1; Dartmouth, 1; Hamilton, 1; Lowell, 4; Marblehead, 2; Marshfield, 1; Natick, 1; Needham, 1; Northampton, 5; Saugus, 1; Springfield, 3; Waltham, 3; Watertown, 1; Wellesley, 2; Winthrop, 1; Worcester, 1; total, 42.

Tetanus: Methuen, 1; West Springfield, 1; total, 2.

Trichinosis: Waltham, 1.

Typhoid fever: Chelmsford, 1; Chicopee, 1; Easthampton, 1; Springfield, 1; total, 4.

CORRESPONDENCE

FRAGMENTS OF ASCLEPIADES

To the Editor: Since publication of my book review on the translation of *Asclepiades* by Robert M. Green, in the May 10 issue of the *Journal*, my attention has been called to two other copies of Gumpert's *Fragments of Asclepiades* (Weimar, 1794), thought to be unique, in the Armed Forces Medical Library. There is a copy in the Library of the College of Physicians, Philadelphia, and another in the Osler Library at Montreal. It is in one volume, not three, as reported in the review.

HENRY R. VIETS, M.D.
Curator,
Boston Medical Library

"MASK OF SANITY"

To the Editor: The editorial in the June 14 issue of the *Journal*, concerning the Chapin case, states, "The question remains whether . . . society . . . should destroy the defective agent of the crime or protect itself by shutting him away forever." This makes excellent sense, but the same editorial says, "society will have had its revenge," calling the death penalty "the law of an eye for an eye and a life for a life."

I propose that we, as physicians, soberly consider only the factual data, and try to arrive at unemotional conclusions, for we may be asked to act as molders of public opinion in this, as in other problems.

Most trained observers believe that Chapin is suffering from psychopathic personality, or, in modern terms, character neurosis. Forensically speaking, he is "sane," for to the examining physicians he shows good orientation, memory, recall and judgment. This "mask of sanity," however, covers a condition incurable at present.

If the only alternative to death on the lawbooks — namely, "life imprisonment," — is pronounced, Chapin will cooperate blandly and be a model prisoner, and walk out of prison, his debt to society paid, in about seventeen to twenty years. And then the terrible thing may happen again: he may kill blandly and with no apparent motive, as before.

It is the duty of the informed press to assume leadership, disseminate the sober facts and press for a change of the laws that will permit such cases to be treated with lifetime isolation (at least until there is a radical change in the prognosis of this malady).

Until such a change, the death penalty is a sad, but true, necessity — not for vengeance and not for Old Testament expiation, but solely for the protection of the children, yours and mine.

Charity begins at home.

GEORGE VASH, M.D.
Chicopee Falls, Massachusetts.

BOOK REVIEWS

Public Health: Its promise for the future: A chronicle of the development of public health in the United States, 1607-1914. By Wilson G. Smillie, M.D., D.P.H. 8°, cloth, 501 pp., with 50 illustrations and 19 tables. New York: The Macmillan Company, 1955. $7.00.

The author is well known for his many studies in the history of the public-health movement in America that have appeared in the periodical literature in the last few decades. The present volume reprints, with revisions, many of these papers, and thus presents them in a convenient form with many additions, expanding the whole subject into a chronology of public health from 1607 to 1914. The author is so modest that he does not even present his own name in the index of the book; yet his *Public Health Administration in the United States* (1936) was something of a landmark in the subject, and *Preventive Medicine and Public Health* (1948) of equal importance. Long an ardent student in the history of his subject, Dr. Smillie, who has dedicated his life to the service of mankind, does not even consider himself an impartial witness. Thus, as he rightly points out, he has produced a chronicle and not a history.

The story begins with smallpox among the Indians in Jamestown in 1607 and is carried up to the opening of World War I in 1914, with a few excursions into the later years on such subjects as school-health services, industrial medicine and the development of the federal health services. In an appendix he lists the great pioneers of public health in America, 1610 to 1925, from Lemuel Shattuck to Milton Rosenau. This strong band of 25 persons comprises a large number of women, including Alice Hamilton, Lillian Wald, Dorothea Dix, and Josephine Baker.

Even in as brief a chronicle as this book presents, many dramatic incidents and the narration of them cannot but call forth an emotional response, in the best sense, in so devoted a disciple as Smillie: Thacher's *Brief Rule* (1677), "which gave great comfort to the people"; Benjamin Waterhouse's "beautifully planned" experiment; yellow fever, in Philadelphia in 1793, the "greatest single disaster that ever occurred to an American city"; and the cholera epidemic of 1845 to 1855, which so affected the gold rush that "thousands and thousands of young, vigorous, hardy men, who started to California to make their fortune, left their bones on the plains along the western trails." Daniel Drake's description of malaria in the area of the Mississippi River, so close to the discovery of the transmission by the mosquito of fifty years later by Ross, leads Smillie to write: "We who can see the answer so plainly long to reach out and help him. If we could only give him a breath of a suggestion. He came so close!" (Oliver Wendell Holmes, writing on puerperal fever, ranks Drake "as America's first outstanding epidemiologist.") The justly famous Lemuel Shattuck *Report* of 1850 and other contributions of a lesser magnitude bring the story up to modern times, with Sedgwick, Welch, Frost, Billings, Chapin, Biggs, Stiles, Ricketts, Vaughan, Kober and Park, all outstanding pioneers in the developmental period of public health in America, from the Civil War to World War I. It is too early to assess the rapid growth in the last forty years; that must be left for "some other author who is more detached and objective than we can be." Until then, all historians, librarians and public-health teachers and workers will welcome Smillie's significant contribution, so skillfully set forth in such a pleasing and readable form.

HENRY R. VIETS, M.D.

Clinical Pathology in General Practice: Specially commissioned articles from the British Medical Journal, October 1953 to July 1954. (Fully revised.) 8°, cloth, 321 pp., with illustrations. London: British Medical Association, 1955. 21s.—

It would be difficult for any physician to read this excellent little book without being a better doctor for it. Interestingly written, with a clarity and simplicity of style that medical literature in general would do well to emulate, it has the unusual merit of being both concise and comprehensive.

The book is a compilation of thirty-nine articles, by different authorities, that recently appeared in the *British Medical Journal*. These articles, or chapters, cover the clinicopathological aspects of virtually the entire field of internal medicine.

The book opens with an interesting and enlightening account of the laboratory organization under the British National Health Service and of the laboratory facilities available to the practicing physician in Great Britain today. These chapters show how useful the laboratories can be to

the physician and how they can help him practice better and more thorough medicine.

The third through tenth chapters deal with practical technics, such as the taking of swabs, the dispatch of specimens, venipuncture, lumbar puncture, pleural, pericardial and peritoneal taps, biopsies and even post-mortem examination, and the taking of forensic specimens. The procedures are well described, and their indications aptly pointed out. The next three chapters deal with urinalysis, renal-function tests and tests for diabetes mellitus. There is a considerable amount of worth-while and well described pathological physiology of value to the general practitioner. The three following chapters, on gastroenterology, give good descriptions of liver-function tests, with the indications for them and the choice of tests to use. There is an excellent discussion of the physiology of gastric secretion and its alteration under various pathologic states, as well as a careful exposition of gastric analyses and the examination of the stool.

The next section of the book is devoted to the laboratory diagnosis of infectious diseases. There is an excellent discussion of antibody tests and the interpretation of the results in a large variety of infectious diseases, with instructions regarding the collecting of blood for such tests. The examination of spinal fluid, urine and feces in specific infectious diseases is described, and there are good chapters on tuberculosis, venereal diseases and laboratory control of chemotherapy in general. The problem of drug resistance is well discussed.

The next section of the book deals largely with hematology and includes an excellent chapter on electrolyte changes in the blood, which has a fine description of the body fluids and acid-base balance. It is impressive how comprehensively and how simply the field of hematology is covered in fifty pages. There are separate chapters on the normal blood picture, iron-deficiency anemia, hyperchromic anemia, hemolytic anemia, leukemia, polycythemia and cytopenia, and blood grouping. The vivid description of the blood picture in leukemia is well worth every physician's attention.

The section on metabolism and endocrinology discusses with ease and great clarity the most up-to-date tests for evaluation of pituitary, thyroid, adrenal and gonadal function, and describes the fundamental physiology of these endocrine glands. The parathyroid glands are not discussed, which puzzles me a bit, and represents the only noteworthy omission that I can spot in the entire book.

The last three chapters deal with skin diseases and the tropical diseases and industrial diseases encountered in Great Britain — the ones, that is, in which the laboratory can contribute to the diagnosis. Berylliosis, for example, is not referred to in the chapter on industrial poisoning, probably because its diagnosis hardly lies within the scope of the clinical laboratory.

In essence, this is far more than a book of clinical laboratory tests, technics and indications. It is written by men who are obviously clinical masters in their fields, and it is filled with clinical wisdom and experience. The anemia of tuberculosis, the possibility of a false-positive serologic reaction after a smallpox vaccination and the fact that "aleukemic" leukemia is an acute and not a chronic leukemia are a few examples of interest discussed here that are probably not familiar to many internists. I most heartily recommend this book, not only to every general practitioner — of every country — but also to the more specialized practitioners of internal medicine.

ARTHUR S. PIER, JR., M.D.

Atlas der Kolpomikroskopie. By Prof. Dr. Tassilo Antoine; and Priv.-Doz. Dr. Viktor Grünberger. 4°, cloth, 244 pp., with 176 illustrations. Stuttgart: Georg Thieme, 1956. DM 64.-$15.25. (Distributed in the United States by Intercontinental Medical Book Corporation, New York City.)

This volume describes a new instrument and shows some of the normal and abnormal pictures seen with it. A brief introduction tells of the development of the incident-light microscope for this purpose and describes the technic. The colpomicroscope is an instrument designed to examine the surface of the cervix under reflected light at moderate magnifications (110 to 280 times). A tubular structure 3 cm. in diameter is inserted in the vagina and pressed against the cervix. The apparatus contains a light as well as the lens system, and is mounted on a movable stand. A preliminary stain of hematoxylin is used to visualize the nuclei and cell borders.

The bulk of the book is devoted to photographs of normal epithelium, erosions and various degrees of malignant degeneration. Most of the fields taken with the colpomicroscope are paired with histologic sections from the same area. The text is in German, with a section on technic in English as well. The legend and explanatory notes on each of the plates are in German, English and Spanish. The volume is well printed on a good grade of paper, with excellent reproduction of the illustrations.

One receives the impression that colpomicroscopy is a research technic yielding information about the surface epithelium that is available in no other way. A major advantage is that it allows serial observations of the same area without destruction of the lesion. Thus, it should afford some insight into the progression or regression of abnormal epithelium. Although it will detect early carcinoma, it is more cumbersome than colposcopy and exfoliative cytology and so will not seriously compete with them for routine detection.

Reading this atlas makes one wish to have the use of a colpomicroscope in the study of normal cervical epithelium, carcinoma in situ and the various gradations in between.

JOHN B. GRAHAM, M.D.

BOOKS RECEIVED

The receipt of the following books is acknowledged, and this listing must be regarded as a sufficient return for the courtesy of the sender. Books that appear to be of particular interest will be reviewed as space permits. Additional information in regard to all listed books will be gladly furnished on request.

Color Atlas of Oral Pathology: Histology and embryology, developmental disturbances, diseases of the teeth and supporting structures, diseases of the oral mucosa and jaws, and neoplasms. Prepared under the auspices of the United States Navy Dental School of the National Naval Medical Center, Bethesda, Maryland. 8°, cloth, 188 pp., with 461 illustrations in color. Philadelphia: J. B. Lippincott Company, 1956. $12.00.

The Truth about Cancer. By Charles S. Cameron, M.D., medical and scientific director, American Cancer Society. 8°, cloth, 268 pp., with 16 illustrations and 28 plates. Englewood Cliffs, New Jersey: Prentice-Hall, Incorporated, 1956. $4.95.

Bellevue Is My Home. By Salvatore R. Cutolo, M.D.; with Arthur and Barbara Gelb. 8°, cloth, 317 pp. Garden City, New York: Doubleday and Company, Incorporated, 1956. $4.00.

Health Observation of School Children: A guide for helping teachers and others to observe and understand the school child in health and illness. By George M. Wheatley, M.D., M.P.H., third vice-president for health and welfare, Metropolitan Life Insurance Company; and Grace T. Hallock, coauthor of *Health for Better Living Series, Understanding Health, Health Heroes Series* and other health books. Second edition. 8°, cloth, 488 pp., with 86 illustrations, 21 tables and 16 plates. New York: The Blakiston Division, McGraw-Hill Book Company, Incorporated, 1956. $6.50.

Progress in Clinical Psychology. Vol. 2. Edited by Daniel Brower, Ph.D.; and Lawrence E. Abt, Ph.D. 8°, cloth, 364 pp. New York: Grune and Stratton, 1956. $7.75.

Textbook of Medical Physiology. By Arthur C. Guyton, M.D., professor of physiology and chairman, Department of Physiology and Biophysics, University of Mississippi School of Medicine. 4°, cloth, 1030 pp., with 577 illustrations and 19 tables. Philadelphia: W. B. Saunders Company, 1956. $13.50.

Clinical Recognition and Management of Disturbances of Body Fluids. By John H. Bland, M.D., associate professor of medicine, University of Vermont College of Medicine. Second edition. 4°, cloth, 522 pp., with 109 illustrations and 54 tables. Philadelphia: W. B. Saunders Company, 1956. $11.50.

The Work of WHO, 1955. Annual report of the Director-General to the World Health Assembly and the United Nations. 4°, paper, 241 pp., with 16 pp. of photographs. Geneva: World Health Organization, 1956. Sw. fr. 6.-, 10/-, $2.00. Available also in French and Spanish editions. (*Official Records of the World Health Organization,* No. 67.) (Distributed in the United States by Columbia University Press, New York City.)

Rorschach Location and Scoring Manual. By Leonard Small, Ph.D., director of Special Research, Vocational Advisory Service, New York City, consulting psychologist, Altro Health and Rehabilitation Service, New York City, and instructor, New York University. 4°, cloth, 214 pp. New York: Grune and Stratton, Incorporated, 1956. $6.50.

Preface to Empathy. By David A. Stewart, chief psychologist, Bell Clinic, Toronto. 8°, cloth, 157 pp. New York: Philosophical Library, 1956. $3.75.

Thresholds of Existence: A cosmogony and theory of evolution as a way of life. By Upton Clary Ewing. 8°, cloth, 286 pp., with 4 illustrations. New York: Philosophical Library, 1956. $3.75.

Scalpel: Men who made surgery. By Agatha Young. 8°, cloth, 312 pp., with 26 illustrations. New York: Random House, 1956. $5.00.

Essentials of Dermatology. By Norman Tobias, M.D., dermatologist, St. Louis State Hospital. Fifth edition. 8°, cloth, 651 pp., with 211 illustrations and a frontispiece. Philadelphia: J. B. Lippincott Company, 1956. $8.00.

NONCLINICAL NOTES

MASSACHUSETTS SOCIETY FOR RESEARCH IN PSYCHIATRY

The Massachusetts Society for Research in Psychiatry elected the following officers for the year 1956-1957: President, Dr. Max Rinkel; vice-president, Dr. Philip Solomon; secretary-treasurer, Dr. Peter H. Knapp; chairman of Program Committee, Dr. Stanley S. Kanter; and chairman of Committee on Constitution, Dr. Myer Asekoff.

NOTICES

MASSACHUSETTS SOCIETY FOR RESEARCH IN PSYCHIATRY

The schedule for the meetings of the Massachusetts Society for Research in Psychiatry is as follows:

Friday, October 19, 1956.
Friday, December 14, 1956.
February, 1957.
April, 1957.

SOCIETY MEETINGS AND CONFERENCES

July 6. International College of Surgeons. Page 1148, issue of June 14.
July 9. Fifth Annual Symposium for General Practitioners. Page 1010, issue of May 24.
July 9–August 28. Consultation Clinics for Crippled Children in Massachusetts. Page 1244, issue of June 28.
August 19–23. American College of Chest Physicians. Page 840, issue of November 10.
September 3–5. Congress on Blood Transfusions, Blood Banks and Hematology. Page 297, issue of February 9.
September 10–14. American Dietetic Association. Page 1180, issue of December 29.
October 19, December 14, 1956 and February and April 1957. Massachusetts Society for Research in Psychiatry. Notice above.
October 30 and 31 and November 1. New England Postgraduate Assembly, Boston.

CALENDAR FOR THE WEEK BEGINNING THURSDAY, JULY 12

THURSDAY, JULY 12
*8:00–8:45 a.m. Case Presentations. Joslin Clinic. Joslin Auditorium, New England Deaconess Hospital.
*8:00–9:00 a.m. Surgical Grand Rounds. Dr. John Spellman and staff. Saint Elizabeth's Hospital.
*8:45–9:45 a.m. Cardiac Grand Rounds. Jimmy Fund Building, Children's Medical Center, 35 Binney Street.
*9:00–10:00 a.m. Surgical Rounds. Sherman Auditorium, Beth Israel Hospital.
*9:00–10:00 a.m. Arthritis Grand Rounds. Robert Breck Brigham Hospital.
*10:00–11:00 a.m. Combined Medical-Surgical Rounds. Sherman Auditorium, Beth Israel Hospital.
10:30–11:15 a.m. Lecture on Diabetes for Doctors and Patients by Members and Guests of the Joslin Clinic. Joslin Auditorium, New England Deaconess Hospital.
*11:00 a.m.–12:00 m. Medical Grand Rounds. Dr. Sylvester McGinn and staff. Saint Elizabeth's Hospital.
*11:00 a.m.–12:00 m. Medical Staff Conference. Sherman Auditorium, Beth Israel Hospital.
*11:00 a.m.–12:00 m. Pediatric Conference. Mount Auburn Hospital.
*11:00 a.m.–12:30 p.m. Hand Clinic (Physical Medicine and Rehabilitation Service). Boston City Hospital.
*12:00 m. Clinicopathological Conference. Dr. Benjamin Castleman and associates. Pathology Amphitheater, Massachusetts General Hospital.
*12:15–1:15 p.m. Tumor Clinic. Dr. T. W. Botsford. Amphitheater, Peter Bent Brigham Hospital.
*3:00 p.m. Thoracic Conference. Hemodynamic Studies by Right and Left Heart Catheterization. Dr. Paul Novack. Main Amphitheater, Peter Bent Brigham Hospital.
5:00 p.m. Case Presentation and Pathological Discussion Followed by Subject of Special Presentation. Joslin Auditorium, New England Deaconess Hospital.

FRIDAY, JULY 13
*8:00–8:45 a.m. Case Presentations. Joslin Clinic. Joslin Auditorium, New England Deaconess Hospital.
*8:00–9:00 a.m. Members and Guests of the Joslin Clinic. Joslin Auditorium, New England Deaconess Hospital.
*9:30–11:30 a.m. Medical and Surgical Grand Rounds. Drs. George W. Thorn and Francis D. Moore. Main Amphitheater, Peter Bent Brigham Hospital.
*10:00 a.m. Tuberculosis Surgical Clinic. South End Health Unit, 57 East Concord Street.
10:30–11:15 a.m. Lecture on Diabetes for Doctors and Patients by Members and Guests of the Joslin Clinic. Joslin Auditorium, New England Deaconess Hospital.
*12:00 m. Pediatric Grand Rounds. Thorndike Amphitheater, Boston City Hospital.
*1:30 p.m. Fertility and Endocrine Clinic. Free Hospital for Women, Brookline.
*1:30 p.m. Tumor Clinic. Mount Auburn Hospital, Cambridge.
*2:00–3:00 p.m. Pathology Conference. Dr. James Graham. Saint Elizabeth's Hospital.
*4:00–10:00 p.m. Alcoholism Clinic. By appointment. Washingtonian Hospital, 41 Morton Street, Jamaica Plain.
*4:30 p.m. Neuroradiologic Conference. X-Ray Conference Room, New England Deaconess Hospital.

SATURDAY, JULY 14
*8:00–8:45 a.m. Case Presentations. Joslin Clinic. Joslin Auditorium, New England Deaconess Hospital.

(Concluded on page xxvi)